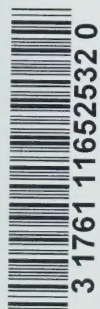


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Ontario

ENVIRONMENTAL ASSESSMENT BOARD

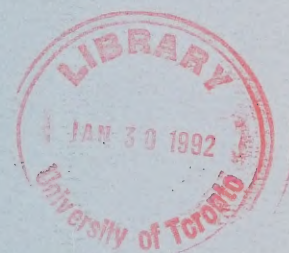
VOLUME: 342

DATE: Monday, January 20, 1992

BEFORE:

A. KOVEN Chairman

E. MARTEL Member



FOR HEARING UPDATES CALL (COLLECT CALLS ACCEPTED) (416)963-1249

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ENVIRONMENTAL ASSESSMENT BOARD

VOLUME: 342

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BEFORE:

A. KOVEN Chairman

E. MARTEL Member

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HEARING ON THE PROPOSAL BY THE MINISTRY OF
NATURAL RESOURCES FOR A CLASS ENVIRONMENTAL
ASSESSMENT FOR TIMBER MANAGEMENT ON CROWN LANDS
IN ONTARIO

IN THE MATTER of the Environmental
Assessment Act, R.S.O. 1980, c.140;

- and -

IN THE MATTER of the Class Environmental
Assessment for Timber Management on Crown
Lands in Ontario;

- and -

IN THE MATTER OF a Notice by the
Honourable Jim Bradley, Minister of the
Environment, requiring the Environmental
Assessment Board to hold a hearing with
respect to a Class Environmental
Assessment (No. NR-AA-30) of an
undertaking by the Ministry of Natural
Resources for the activity of timber
management on Crown Lands in Ontario.

Hearing held at the offices of the Ontario
Highway Transport Board, 10th Floor,
151 Bloor Street West, Toronto, Ontario, on
Monday, January 20th, 1992, commencing at
9:00 a.m.

VOLUME 342

BEFORE:

MRS. ANNE KOVEN
MR. ELIE MARTEL

Chairman
Member

A P P E A R A N C E S

MR. V. FREIDIN, Q.C.)	
MS. C. BLASTORAH)	MINISTRY OF NATURAL
MS. K. MURPHY)	RESOURCES
MR. B. CAMPBELL)	
MS. J. SEABORN)	MINISTRY OF ENVIRONMENT
MS. N. GILLESPIE)	
MR. R. TUER, Q.C.)	
MS. E. CRONK)	ONTARIO FOREST
MR. R. COSMAN)	INDUSTRIES ASSOCIATION
MR P. CASSIDY)	
MR. D. HUNT)	
MR. R. BERAM	ENVIRONMENTAL ASSESSMENT BOARD
MR. D. O'LEARY)	ONTARIO FEDERATION OF
MR. E. HANNA)	ANGLERS & HUNTERS AND
DR. T. QUINNEY)	NORTHERN ONTARIO TOURIST
	OUTFITTERS ASSOCIATION
MR. D. HUNTER)	NISHNAWBE-ASKI NATION
MR. M. BAEDER)	and WINDIGO TRIBAL COUNCIL
MS. M. SWENARCHUK)	FORESTS FOR TOMORROW
MR. R. LINDGREN)	
MR. D. COLBORNE)	GRAND COUNCIL TREATY
MR. G. KAKEWAY)	#3.
MR. J. IRWIN	ONTARIO METIS & ABORIGINAL ASSOCIATION
MR. J. ANTLE	NORTHERN ONTARIO TOURIST OUTFITTERS ASSOCIATION
MS. M. HALL	KIMBERLY-CLARK OF CANADA LIMITED and SPRUCE FALLS POWER & PAPER COMPANY

APPEARANCES: (Cont'd)

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MR. R. BARNES)	ASSOCIATION
MR. L. GREENSPOON)	NORTHWATCH
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MR. J.W. ERICKSON, Q.C.)		RED LAKE-EAR FALLS
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MR. H. GRAHAM		CANADIAN INSTITUTE OF FORESTRY (CENTRAL ONTARIO SECTION)
MR. G.J. KINLIN		DEPARTMENT OF JUSTICE
MR. S.J. STEPINAC		MINISTRY OF NORTHERN DEVELOPMENT & MINES
MR. M. COATES		ONTARIO FORESTRY ASSOCIATION
MR. P. ODORIZZI		BEARDMORE-LAKE NIPIGON WATCHDOG SOCIETY

APPEARANCES: (Cont'd)

MR. R.L. AXFORD	CANADIAN ASSOCIATION OF SINGLE INDUSTRY TOWNS
MR. M.O. EDWARDS	FORT FRANCES CHAMBER OF COMMERCE
MR. P.D. McCUTCHEON	GEORGE NIXON
MR. C. BRUNETTA	NORTHWESTERN ONTARIO TOURISM ASSOCIATION

I N D E X O F P R O C E E D I N G S

<u>Witness:</u>	<u>Page No.</u>
<u>WILLIAM WADE CARR</u> , Affirmed	59665
Direct Examination by Mr. O'Leary	59665

I N D E X O F E X H I B I T S

<u>Exhibit No.</u>	<u>Description</u>	<u>Page No.</u>
2041	OFAH/NOTO Panel 3 witness statement entitled: Management Approaches to Site Protection.	59665
2042	Four-page errata re: Panel 3 witness statement of OFAH/NOTO.	59666
2043	Interrogatory responses (17 pages) re: OFAH/NOTO Panel 3.	59668
2044	Set of overheads to be used by Dr. Carr in evidence.	59686
2045	Three-page excerpt from A Field Guide for Identification and Interpretation of Ecosystems, published by Ministry of Forests and Lands, British Columbia, dated May, 1984.	59691
2046	FRDR Report 25 titled: Evaluation of Soil Degradation as a Factor Affecting Forest Productivity in British Columbia, A Problem Analysis dated March, 1988 authored by Utzig and Walmsley.	59744

1 ---Upon commencing at 10:30 a.m.

2 MADAM CHAIR: Good morning, please be
3 seated.

4 Good morning, Dr. Carr.

5 DR. CARR: Good morning.

6 MADAM CHAIR: Mr. O'Leary, Mr. Hanna.

7 MR. O'LEARY: Madam Chair, Mr. Martel.

8 MR. MARTEL: Good morning.

9 MADAM CHAIR: Let's get started, Mr.
10 O'Leary.

11 MR. O'LEARY: Thank you, Madam Chair. I
12 just wanted to say at the outset that I hope that the
13 numbers in attendance is no reflection on the
14 activities of last week, but there's a modest crowd
15 here today.

16 The witness panel consists solely of Dr.
17 William Carr, Madam Chair, and I would ask Dr. Carr
18 first to turn to a document entitled: Panel 3,
19 Management Approaches to Site Protection. That's the
20 document contained in your witness statement, Dr.
21 Carr.

22 MADAM CHAIR: Shall we give it an exhibit
23 number, Mr. O'Leary?

24 MR. O'LEARY: Madam Chair, yes.

25 MADAM CHAIR: This will be Exhibit 2041.

---EXHIBIT NO. 2041: OFAH/NOTO Panel 3 witness statement entitled: Management Approaches to Site Protection.

MR. O'LEARY: While we're on the procedural side, perhaps we should have him sworn as well.

MADAM CHAIR: Good idea. Would you like
to be sworn or affirmed, Dr. Carr?

DR. CARR: Affirmed, please.

WILLIAM WADE CARR, Affirmed

MADAM CHAIR: Thanks, Dr. Carr.

DIRECT EXAMINATION BY MR. O'LEARY:

Q. All right. Would you please turn to the very first portion of that document, being Exhibit 2041, Dr. Carr, and it is a witness statement.

Can you tell me, was that document prepared by you or at your direction or under your supervision?

A. Yes, it was. It was prepared by me and under my supervision, I directly prepared it.

Q. All right, thank you. And I understand that there are some small changes to that document and they have been reproduced in the form of an errata for Panel 3?

A. Yes, they have.

Q. All right. And can you tell me, have

1 you seen that written list of errata for Panel 3?

2 A. Yes.

3 Q. All right. And were those changes
4 made at your request or under your direction or
5 supervision?

6 A. Yes, they were.

7 Q. All right. Are there any additional
8 changes to your witness statement which you would like
9 to make and, in particular, just for your memory, I
10 might refer you to page 13, Question 21.

11 MADAM CHAIR: Mr. O'Leary, we will give
12 the errata an exhibit number.

13 MR. O'LEARY: Yes.

14 MADAM CHAIR: 2042.

15 MR. O'LEARY: Thank you, Madam Chair.

16 MADAM CHAIR: And the errata have four.
17 pages.

18 ---EXHIBIT NO. 2042: Four-page errata re: Panel 3
19 witness statement of OFAH/NOTO.

20 THE WITNESS: There is one additional
21 slight typographic error that was missed in a previous
22 review. Under soil compaction, third line down, there
23 is a statement:

24 "By some form of evacuation...", and then
25 parenthesis (blading), it should be 'excavation'.

1 MADAM CHAIR: What page was that, Dr.
2 Carr?

3 THE WITNESS: Page 13, Question 21.

4 MR. O'LEARY: Third line of the first
5 paragraph.

6 THE WITNESS: Third line under
7 compaction.

8 MADAM CHAIR: And it was not evacuation,
9 it was --

10 THE WITNESS: Excavation.

11 MADAM CHAIR: Excavation. I see.

12 THE WITNESS: Very similar to what is
13 under displacement, second line, where it says
14 excavation I meant the same.

15 MR. O'LEARY: Q. Thank you, Dr. Carr.
16 Now, would you please turn to the interrogatory
17 responses to the various parties. Do you have that
18 document in front of you?

19 A. I have it.

20 Q. All right. Can you tell me, were
21 your responses prepared by you or under your direction
22 or supervision?

23 A. Yes, they were.

24 Q. And do you have any changes or
25 revisions to that document?

1 A. Not at this time.

2 MR. O'LEARY: Perhaps we could mark that
3 as an exhibit as well, Madam Chair.

4 MR. HANNA: (handed)

5 MADAM CHAIR: I think this would be
6 Exhibit 2043, and these are the responses to the
7 interrogatories for Dr. Carr's evidence and comprises
8 17 pages.

9 ---EXHIBIT NO. 2043: Interrogatory responses (17
10 pages) re: OFAH/NOTO Panel 3.

11 MR. O'LEARY: Q. Now, Dr. Carr, do you
12 adopt the witness statement, the written errata, the
13 errata you just gave in oral evidence and the
14 interrogatory responses as your evidence before this
15 hearing?

16 A. Yes, I do.

17 Q. Thank you. Now, may I turn to you
18 Exhibit 2041 and, specifically, Tab No. 1 which is
19 ostensibly your curriculum vitae and I ask you, to
20 start out with, with whom you are presently employed?

21 A. I'm presently employed by Terrasol in
22 Vancouver, British Columbia.

23 Q. And what are your duties and
24 responsibilities with that firm?

25 A. I'm the manager of the environmental

1 consultant division. I oversee all of our
2 environmental consultants in both conducting the
3 consulting and securing work for others on our staff.

4 Q. All right. And your curriculum vitae
5 indicates you have been with that firm since 1984 up
6 until the present time?

7 A. Yes.

8 Q. Have you been employed in the same
9 capacity all that period?

10 A. Yes, I have.

11 Q. All right, thank you. Now, with your
12 finger at Tab 1 I would also ask you to also turn to
13 your response to Question No. 4 of the witness
14 statement, and in that your response states that you:

15 "...wish to be qualified to give opinion
16 evidence in these proceedings about
17 forest management and forest soils, soil
18 science, soil erosion and sediment
19 control in timber harvesting impacts."

20 I wonder if you could briefly assist us
21 by advising whether any of your past employment
22 experience - and refer to your curriculum vitae if you
23 like, sir - has any relevance to any of the areas in
24 which you wish to be qualified as an expert here today.

25 Perhaps you could start with Terrasol.

1 A. Yes. Well, with regards to Terrasol,
2 a large part of my research and consulting has been
3 specifically on the impacts of timber harvesting on the
4 soil, water resources, a great deal of contract
5 research as well as operational consulting to deal with
6 Ministry of Forests, various companies, Department of
7 Fisheries and Oceans and Forestry Canada.

8 Q. All right. Now, when I ask you in
9 respect of all of the areas where you've worked, feel
10 free to refer to all of the different areas under
11 Question No. 4. Do you have that before you?

12 A. Yes.

13 Q. All right. Do you have anything else
14 to state in respect to Terrasol?

15 A. Well, it's been at Terrasol primarily
16 where I've been involved in all of the issues under
17 Question 4.

18 Q. All right. Can you tell us, is there
19 anything of significance that you would like to draw to
20 the Board's attention as a result of your work
21 experience with the BC Ministry of Forests from 1978
22 through to 1984?

23 A. That work with the BC Ministry of
24 Forests was specifically a five-year -- became a
25 five-year experimental program, as they call them,

1 where I was dealing with the issues of soil erosion,
2 site degradation. The formal name of the project was
3 The Rehabilitation of Severely Degraded Soils or Lands.

4 It's been a while. If you wish to
5 refer -- look at page 12 of my curriculum vitae, that
6 is a very detailed description of the activities that
7 were undertaken at that time.

8 They deal with erosion control, soil
9 compaction, soil disturbance, the nutritional problems,
10 primarily looking at degraded sites. That's the main
11 crux of what I was doing at that time.

12 Q. Since you've referred us now to page
13 12, Dr. Carr, is there anything of interest that you
14 feel, other than what you have said already, that might
15 be of assistance in helping this Board understand your
16 qualifications?

17 A. Really if you went down the entire
18 list of major projects I believe that they address all
19 the issues that are under No. 4. There's development
20 of erosion control handbooks and guides.

21 Q. I'm just talking about page 12 now,
22 I'm talking about the EP 834, we're still on --

23 A. That's a major project one. If you
24 went down, you would see that they all pertain to the
25 various aspects of forestry soil interactions with

1 regards to disturbance to degradation and
2 rehabilitation.

3 Q. All right, thank you.

4 A. I should say it was after, when this
5 contract ended, that was when I went to Terrasol, but I
6 still continued to do a lot of my work at that time as
7 a contract researcher for the Ministry of Forests.

8 Q. Thank you. Now, how about your
9 position as a lecturer in forest soils at the
10 University of British Columbia, 1980.

11 A. That became more specifically to my
12 being qualified under soil science and forest soils
13 impacts.

14 Q. All right.

15 A. I taught a third year forestry course
16 on soil science at the College of New Caledonia as sort
17 of an extension of the UBC Department of Agriculture.

18 Q. All right. And you also indicate in
19 your CV that you were an independent consultant and
20 erosion control specialist in 1976 through 1978, and
21 that your clients included the BC Ministry of Forests,
22 the BC Forest Products and Pacific Forest Products.

23 Can you tell me a little bit more about
24 your experience there and how it relates to the
25 qualifications you seek to be attributed today?

1 A. At that time the principal thrust of
2 my consulting was in sediment, erosion control which is
3 one of the areas under Tab 4 -- I mean, under Question
4 4, that was a number of operational projects of
5 assisting these forest companies and the agencies sees
6 in dealing with specific erosion problems on various
7 sites throughout British Columbia.

8 Q. All right. And can you give us an
9 idea of the level of your personal involvement?

10 A. I was doing the consulting, designing
11 the rehabilitation prescription, as well as undertaking
12 the rehabilitation activities, whether it be seeding,
13 planting or supervising the other aspects.

14 Q. All right. Can I also ask you the
15 same question in respect of Terrasol, I would like to
16 know the level of your personal involvement and what
17 you told us you have been doing with that firm?

18 A. For a long time I was the consultant
19 division.

20 Q. All right.

21 A. So everything done was me. In other
22 projects I will often do the design now and I that will
23 go to our operations division where they will either --
24 undertake the activity that we recommend.

25 Q. Okay. Now, turning to page 1 of your

1 CV, Dr. Carr, you indicate that you have a Ph.D. from
2 the University of British Columbia Faculty of Forestry.
3 I understand your major was forest management?

4 A. Yes, it was. The topic of my thesis
5 and the area where I studied was specifically the
6 relationship between degraded sites, productivity and
7 forest management.

8 Q. All right. And at the Oregon State
9 University you were involved in advanced silviculture.
10 Can you tell us a little more about that?

11 A. That was part of the course work for
12 my Ph.D. where I went down to take some advanced
13 courses in silviculture, hydrology, cable logging
14 systems, really just to provide more of a background.

15 Q. Okay. Anything else that occurred at
16 Oregon State University that would be of assistance to
17 this Board in understanding your qualifications?

18 A. No.

19 Q. Okay. Back to UBC, and I understand
20 you received a Masters of Science from the Faculty of
21 Forestry in 1977 with your major being forest soils.
22 Can you elaborate on that?

23 A. That was part -- was my Masters. The
24 topic of my thesis research was specifically the
25 impacts of soil erosion through forest roads.

1 MR. FREIDIN: Sorry, the impact of forest
2 erosion, I didn't hear the rest.

3 THE WITNESS: The impacts of forest
4 erosion related to road construction.

5 MR. O'LEARY: Q. All right. And I
6 understand you obtained your Bachelor of Science from
7 Organ State University in 1975 and your major was
8 forest management. Would you like to elaborate on
9 that, Dr. Carr?

10 A. Just as far as providing background
11 really for all the others. It's difficult to deal in
12 reverse order.

13 Q. All right.

14 A. That was the fundamental basis.
15 Oregon State was ranked as one of the top forestry
16 schools in the US.

17 Q. Fair enough. You might have to speak
18 a little louder now that we have some problem outside.

19 MR. O'LEARY: Were you able to hear the
20 last?

21 MADAM CHAIR: Yes, we were, Mr. O'Leary.

22 MR. O'LEARY: Q. Under the heading
23 professional status, Dr. Carr, you state:

24 "Certified professional soil erosion and
25 sediment control specialist."

1 Can you tell me what qualifications are
2 required to obtain that designation?

3 A. That is a designation that I obtained
4 through the Soil Water Conservation Society, it's an
5 international designation that, depending -- there's a
6 variety of levels that are required.

7 A non-university degree would require 10
8 years of field experience, and then as you work your
9 way up the field experience is offset by academic
10 experience. I qualified with my Ph.D. and six years of
11 experience in the practical field of sediment meant
12 erosion.

13 Q. All right, thank you. Moving along
14 now to page 4 of your CV, Dr. Carr, I have no
15 intention - the parties will be happy to hear - to take
16 you through all of the substantial number of reports
17 and publications which you have authored or
18 co-authored.

19 Perhaps the way to ask you is: I count
20 33 of them. Could you point out those reports in which
21 you've been involved which did not relate to the four
22 areas in which you seek to be qualified to give opinion
23 evidence here today?

24 A. I don't believe that any of them are
25 not directly related.

1 Q. Thank you.

2 A. It's been my life blood.

3 Q. All right. Are there any of any
4 particular significance that -- I understand you may
5 make reference to one or several during your
6 examination-in-chief and perhaps your
7 cross-examination, but are there any of particular
8 significance that you would like to draw the Board's
9 attention to at this point for the purpose of
10 determining your qualifications today?

11 A. I would just like to highlight. A
12 few of the key ones would be the first one, Arnott
13 Carr and Waines.

14 Q. Arnott.

15 A. Arnott, Carr, Waines.

16 Q. A-r-n-o-t-t -- sorry, I'm just going
17 to spell it for the reporter. A-r-n-o-t-t, Carr and
18 Waines, W-a-i-n-e-s.

19 A. That was a joint project that I
20 worked with the Forestry Canada researcher in looking
21 at the long-term impacts of soil compaction,
22 reforestation and the impacts on seedling height
23 growth. That was subsequently published in the Forest
24 Chronicle.

25 I just wanted to hit some of the

1 highlights. Possibly on page 5 ones that quite -- well
2 the top of page 5, a contract report for the BC
3 Ministry of Forests dealing with specific testing of
4 the decompaction of soil, utility equipment, field
5 trials, evaluating equipment as far as the capability
6 to offset the impact of forces as it impacts on soils.

7 Third from the bottom, Carr, 1987 that's
8 the FDRA Report, BC FRDA Report 003 which I believe has
9 been put forth as evidence. That is a specific case
10 where we have looked at comparative soils on degraded
11 sites versus non-degraded sites.

12 Page 6, midway down, Carr, 1985. The
13 first '85 publication, Land Management Report 36 from
14 British Columbia dealing specifically with the
15 rehabilitation of watersheds and disturbed slopes.
16 This was on the Queen Charlotte Islands.

17 The next one was the -- title was my
18 doctoral thesis would be, Restoring Productivity on
19 Severely Degraded Forest Sites in British Columbia.

20 If you went to page 8, Carr, Mitchell,
21 Watt, 1990, that is Land Management Report 63 which was
22 recently released dealing specifically with basic soil
23 interpretation with regards to surface soil erosion,
24 and compaction hazards.

25 Lewis and Carr, 1990, which is included

1 behind Tab 7, which is the field guide for British
2 Columbia on determining soil sensitivity to man-made
3 predictions, or prescriptions to minimize site
4 disturbance. That's just sort of to highlight some of
5 them.

6 Q. Thank you. Turning to the next page,
7 on page 9 - again, I don't propose to ask you to go
8 through each of the major projects you've identified in
9 your CV - perhaps you could, however, continue on and
10 indicate which projects might be of more significance
11 in terms of understanding your qualifications to give
12 expert evidence?

13 A. On page 9, the first project
14 that's -- of the major projects, Greater Vancouver
15 Regional District, I was a senior member of the review
16 team for the development of the watershed management
17 program, review and development of the watershed
18 program for the municipal watershed of Vancouver, a
19 very major undertaking which was just recently
20 completed and we're providing recommendations to the
21 Board.

22 Not on here is that we -- I'm now project
23 manager for a similar review for Greater Victoria
24 Regional District, looking at timber harvesting
25 practices within a municipal watershed and what the

1 impacts would be on drinking water quality standards.

2 Below that, interior forest regions.

3 This comes out of the publication Lewis and Carr. We
4 have developed a workshop for the Ministry of Forests
5 and have presented it throughout the province on
6 specifically the field guide, Planning to Minimize
7 Timber Harvesting Impacts as far as site degradation
8 are concerned.

9 It's a two-day workshop. In excess of, I
10 believe at the last count in the last three years we've
11 given 26 of them. We taken them out throughout the
12 province dealing with everybody from foresters to Cat
13 operators to technical people.

14 Q. Dr. Carr, can you tell me a little
15 more about your personal involvement in those
16 workshops?

17 A. In conjunction with Dr. Terry Lewis,
18 he and I developed the workshop and training package
19 and I have been involved in giving 25 out of the 26.

20 It's a two-man show, I'm half of it.

21 Q. Okay. Can I ask you to continue
22 then. Any other major projects of significance?

23 A. The next one, the Kamloops Forest
24 Region and the Vernon Forest District, that is an
25 ongoing research project in conjunction with the

1 regional pedologist in Kamloops Forest Region which is
2 one of the larger regions in the central interior, and
3 there we were looking at long-term impacts of steep
4 slope logging, primarily looking at the impact of
5 skidder logging and Cat logging on specific sites,
6 monitoring all the soil parameters in the disturbance
7 classes.

8 And that has been completed. We are now
9 in the process of finalizing our five-year regeneration
10 of height growth data. So it's part of the long-term
11 study that will be completed.

12 I designed the project and now oversee
13 just the monitoring and we are writing the publication
14 at this time.

15 The next one is -- obviously the Kamloops
16 Forest Region paid for the funding of the Land
17 Management Report 63 which is the component of
18 specifically the soil erosion and soil compaction
19 hazard indices, the development of them for British
20 Columbia.

21 If you went to page 10, working with the
22 Fish/Forestry Interaction Program, which is a component
23 of the BC Ministry of Forest Research Branch, I dealt
24 specifically while looking at, and have developed, a
25 planning system for operational watershed control,

1 watershed restoration and erosion control.

2 This is currently being published, I had
3 hoped it would be released, but it is -- will be
4 adopted as the planning framework to deal with erosion
5 in watersheds that are being developed for timber.

6 On page 11 at the top for the Department
7 of Fisheries and Oceans, when they were developing the
8 Fish Forestry Guidelines for Coastal British Columbia I
9 wrote the appendix specifically to do with sediment,
10 erosion and erosion control.

11 The last project on that page with the
12 Canadian Forestry Service, that refers to the Arnott
13 joint project which was published in Forestry Canada.
14 Just a bit of an overview.

15 Q. Thank you, Dr. Carr.

16 MR. O'LEARY: Madam Chair, we've briefly
17 reviewed Dr. Carr's CV and I respectfully submit that
18 he is qualified to give opinion evidence in respect of
19 those areas identified in his response to Question 4 in
20 the witness statement.

21 MADAM CHAIR: Do the parties object to
22 Dr. Carr being qualified as an expert on forest
23 management of forest soils, soil science, soil erosion
24 and sediment control and timber harvesting impacts?

25 Mr. Freidin?

1 MR. FREIDIN: No objection. As long as
2 the evidence is limited to the subject matter in
3 question in the witness statement, as opposed to forest
4 management more broadly defined, I have no problem.

5 MADAM CHAIR: Ms. Seaborn?

6 MS. SEABORN: No objection, Madam Chair.

7 MADAM CHAIR: Dr. Carr will be so
8 qualified.

9 MR. O'LEARY: Thank you, Madam Chair.

10 Q. Dr. Carr, can you tell me when you
11 were first contacted by the Ontario Federation of
12 Anglers & Hunters?

13 A. I first became acquainted with the
14 Ontario Federation of Anglers & Hunters in 1985. I
15 happened to be in Ottawa giving a paper at the Canadian
16 Land Reclamation Conference. Specifically the paper
17 that I was giving was the development of policy in
18 British Columbia with regards to site degradation. We
19 were in the formative stages at that time, and that is
20 when members of the OFAH were in attendance.

21 We discussed the issue afterwards and
22 over the past few years we subsequently traded -- I
23 have sent reports and papers to them as requested or as
24 they became available.

25 Q. Can I ask you, did I hear you

1 correctly, did you say 1985? Is that the date you
2 used, or did I...

3 A. I have to check the date of the
4 paper. I believe it was '85.

5 Q. All right.

6 A. No, wait a minute. '88 that
7 conference. Give me a second, please. It would have
8 been 1988, I'm sorry.

9 Q. Thank you, Dr. Carr. Can you briefly
10 summarize the relationship you've had with the Ontario
11 Federation of Anglers & Hunters and the nature of any
12 communication you had with them between your first
13 encounter in 1988 and today's appearance?

14 A. Well, subsequent to sort of trading
15 information and sending them our reports as we
16 progressed in the development of policy and procedures
17 in British Columbia, I believe it was in October --
18 well, they had contacted me in April with regards to
19 potentially assisting them in development of their case
20 and it was not again until October when I was contacted
21 that they wanted to go ahead and proceed with the
22 development of the evidence that's presented before
23 you.

24 Q. Dr. Carr, would you please turn to
25 your witness statement, page No. 6, Question No. 8, and

1 in that response you are responding to a question which
2 is:

3 "What is the purpose of this panel's
4 evidence?"

5 Can I ask you if you have any additional
6 comments in addition to those contained in the response
7 to that question?

8 A. Yes, I do.

9 Q. In fact, I understand you have
10 several overheads that you are going to use; is that
11 correct?

12 A. Yes, I do.

13 MR. O'LEARY: Madam Chair, perhaps for
14 the sake of all parties we could mark the set of
15 overheads -- yes, I believe we have a set that we could
16 give to all parties at this point, if you were so
17 inclined to mark it as an exhibit.

18 MADAM CHAIR: How many overheads, Mr.
19 O'Leary?

20 Dr. Carr?

21 DR. CARR: There are nine.

22 MADAM CHAIR: Nine, thank you. That will
23 be Exhibit 2042.

24 MR. FREIDIN: 2044 I think, Madam Chair.

25 MADAM CHAIR: That's right, Mr. Freidin,

1 2044.

2 ---EXHIBIT NO. 2044: Set of overheads to be used by
3 Dr. Carr in evidence.

4 MR. O'LEARY: I count 15 pages. Sorry,
5 for interrupting, Dr. Carr.

6 THE WITNESS: I think there may be more
7 than nine pages. They're sort of blocked into groups
8 of nine, but my apologies.

9 MADAM CHAIR: 15 pages then.

10 THE WITNESS: Yes. May I proceed?

11 MADAM CHAIR: Go ahead, Dr. Carr.

12 THE WITNESS: The purpose part of it is
13 outlined in my answer to Question 8, is to look at the
14 issue of site degradation and to demonstrate that it is
15 a timber management problem, it's very pervasive
16 throughout the world, it is very pervasive in British
17 Columbia and I hope to demonstrate that it should be
18 and is a concern within Ontario.

19 That site degradation can be defined and
20 measured both in qualitative and quantitative terms,
21 that if you have the right planning and understanding
22 of the process, that is the key to minimizing the
23 impacts.

24 If you understand the issue, you can plan
25 and improve timber harvesting practices and activities.

1 And that in cases, where obviously timber harvesting,
2 a component of it is access roads, you're going to
3 disturb the soil, that when you do disturb it to a
4 point of affecting productivity that, in many
5 instances, there are activities available to
6 rehabilitate and deal with the consequences immediately
7 after harvesting to minimize the long-term effects.

8 A lot of this will be framed in the
9 systemic approach that we are currently using in the
10 interior regions of British Columbia with regards to
11 site degradation.

12 It has become one of the biggest issues
13 over the past few years and we now have a system in
14 place which I will discuss later on in the statement.

15 MR. O'LEARY: Q. Now, Dr. Carr, in the
16 scoping session for Panel 3's evidence the Board
17 requested that this panel indicate what evidence exists
18 for Ontario that demonstrates that site degradation
19 from timber management activities is a significant
20 problem warranting their attention.

21 And you've indicated, as we've reviewed
22 your curriculum vitae, that much of your work
23 experiments and various journals and academic papers
24 which you have authored or co-authored relate to your
25 activities and experience in British Columbia.

1 I wonder if you could comment as to the
2 relevance, if any, of your work experience on these
3 academic works in relation to Ontario and the concerns
4 that is before this Board in this hearing in terms of
5 site degradation?

6 A. First, I would like to say it's just
7 not academic works, a lot of it are operational works,
8 not just research and studies, but a lot of practical
9 work out in the field in dealing with these issues.

10 Q. Thank you.

11 A. Having seen that this was coming from
12 your comments earlier in, I've tried to frame this
13 within -- there are three major components that I think
14 make the work that I've been involved in and all the
15 others, it's not just my work there's -- it's really
16 become a team effort in British Columbia.

17 The relevance of that work to Ontario,
18 first, I would like to point out that although many
19 people think of British Columbia and forestry as this
20 big rain forest, massive trees, the vast majority of
21 the timber harvesting in British Columbia is carried
22 out in the interior regions and the interior regions
23 are not the mountains and the big trees, they are flat,
24 gentle terrain, rolling hills, and a great deal --
25 they're actually termed plateaus as far as even the

1 physiographic classification.

2 And the dominant, what is called
3 conventional logging system in the interior of British
4 Columbia is ground skidding, the use of conventional
5 rubber tired skidders, wide-tired skidders, low ground
6 pressure equipment such as the FMC or now KMC which is
7 a tracked low ground pressure vehicle, and in the
8 interior cable logging probably represents less than
9 five per cent of the area harvested.

10 Cable logging which in the big trees you
11 think of are just the coast, and that the type of
12 timber that is being harvested is lodgepole pine, black
13 and white spruce, some hardwood species that are very
14 small in diameter.

15 It's quite a change to go from the coast
16 where you're looking at two to three logs per logging
17 truck load to go to the interior where there's 40, 50,
18 60 smaller logs on a truck.

19 Good point. How can you make money. So
20 I think the logging systems I think are quite
21 comparable from what I've read of the MNR presentation
22 and other work, that it is ground based systems that
23 are dominant in the area of the undertaking.

24 The second aspect has to do with very
25 similar ecosystems. I have mentioned a little bit of

1 the timber type, but the broad expanse of British
2 Columbia that I'm really talking about which are
3 considered to be the interior plateau, the great
4 plains, which is the Peace River area and your northern
5 plateaus, they are all within the boreal forest regions
6 of Canada.

7 And the bulk of my work and the bulk of
8 the site degradation work in British Columbia has been
9 in the interior plateau which is -- and some of the
10 other areas further north, so we are looking at what we
11 would call the subboreal spruce, subboreal pine, boreal
12 white and black spruce ecosystems and in comparing the
13 description of these ecosystems to the type of
14 ecosystems in the boreal forests you have in the area
15 of the undertaking, there's a high degree of
16 similarity.

17 Q. Dr. Carr, I understand that you have
18 with you a portion of a document entitled: A Field
19 Guide for Identification and Interpretation of
20 Ecosystems. That is dated May, 1984.

21 A. Yes.

22 Q. Can I ask you whether or not that is
23 of any relevance to your discussion at this point?

24 A. From a reference standpoint, yes, it
25 is. These are our -- the field guides with regards to

1 the British Columbia system. The two -- well, that I
2 brought you have a portion of, has to do with one of
3 the boreal sub -- one of the boreal ecosystems, the
4 boreal.

5 Q. And at your request, did we prepare
6 copies of relevant sections of that document?

7 A. Yes, you did.

8 Q. All right.

9 THE WITNESS: The components were
10 prepared to pertain specifically to the boreal black
11 spruce. One of the subzones, just to give an
12 indication that I believe we're dealing with very
13 comparable systems --

14 MADAM CHAIR: Do you want this to be
15 made an exhibit, Mr. O'Leary.

16 MR. O'LEARY: I would ask that that be
17 done, Madam Chair.

18 MADAM CHAIR: This will become Exhibit
19 2045, and it is a three-page excerpt from A Field Guide
20 for Identification and Interpretation of Ecosystems,
21 published by the Ministry of Forests and Lands in
22 British Columbia and dated May, 1984.

23 ---EXHIBIT NO. 2045: Three-page excerpt from A Field
24 Guide for Identification and Interpretation of
25 Ecosystems, published by Ministry of Forests
and Lands, British Columbia, dated May, 1984.

1 THE WITNESS: Not only do I feel that we
2 are dealing with very similar ecosystems, and obviously
3 the forest types of both pine forests and spruce
4 forests, mixed wood and deciduous forests, but the
5 soils in these areas also is quite similar in that they
6 are glacially derived, they are developed in cold
7 climates, short growing seasons.

8 And when you look at the classification
9 of the soils you're primarily dealing from a forestry
10 standpoint with brunisols, podzols, luvisols and
11 gleysols.

12 And when you look at detailed
13 descriptions of the BC ecosystems, the descriptions
14 that are contained, say, in the forest ecosystem
15 classification of northwest Ontario, the same soil
16 types are brought forth with very similar origins of
17 morainal deposits, geofluvian deposits.

18 So you have similar soils that have
19 developed under similar conditions, the ecosystems have
20 resulted as a combination of the soils, the topography,
21 the cold climate, the boreal area. So I think that a
22 lot of it is very relevant.

23 MR. O'LEARY: Q. Have you given any
24 consideration as to how well the -- or how relevant the
25 situation in northern Ontario is with that of the

1 interior of BC? Do you have any understanding?

2 A. Have I given it consideration?

3 Q. Yes.

4 A. Yes.

5 Q. You have?

6 A. Yes.

7 Q. And that's for the purposes of
8 today's testimony?

9 A. Yes, it is.

10 Q. All right. Do you wish to move on
11 now. All right. If you would then turn, Dr. Carr, to
12 Question 12 found at page 8 of your witness statement,
13 you were asked to define the term site degradation.

14 A. Yes, I was.

15 Q. All right. Are you able to, at this
16 point, distinguish between a definition for degradation
17 and that for disturbance?

18 A. Yes. With regards -- this has been
19 an issue in British Columbia that took a long time and
20 we spent much of our workshops trying to get this point
21 across, that in a generic form site degradation is the
22 reduction of the long-term productivity of the site by
23 management activities, and this can include both timber
24 and non-timber values.

25 With regards to the timber value

1 component, and specifically site degradation and
2 productivity, it comes down to soil degradation, and
3 you will have soil disturbance due to timber harvesting
4 operations, there's no doubt, and you will have changes
5 in the parameter of soil physical, chemical and
6 biological properties. The disturbance may be good or
7 may be bad.

8 Degradation occurs when that disturbance
9 pushes the soil - one soil parameter, say, soil
10 density - to the point it now affects tree growth. So
11 it's a threshold type of distinction, and when you
12 cross that you've gone from soil disturbance to
13 degradation.

14 Q. Thank you, Dr. Carr. I would like to
15 discuss with you several types of degradation that are
16 contained in your witness statement and I'd ask you to
17 turn to Question 21 found at page 13.

18 A. Okay.

19 Q. And there are six types that are
20 identified in Question 20. You refer and define -- or
21 you speak to four of them in response to Question 21,

22 I wonder if you can elaborate further and
23 briefly on what each of these different types of site
24 degradation consist of?

25 A. The process involved in site

1 degradation, as we have been studying them in British
2 Columbia, you have -- degradation can be caused by one
3 or a combination of the processes of compaction,
4 increase in soil density of the soil, soil displacement
5 where you have the removal of your nutrient pool,
6 removal of your well structured soil, you could have
7 soil erosion, surface erosion, surface erosion that
8 transported material off site, mass wasting, get mass
9 movement of the soil off site, there can also be
10 changes in the site hydrology due to timber harvesting
11 operations, as well as microclimate changes that may
12 affect regeneration and future tree production.

13 Q. I note, Dr. Carr, that under Question
14 21 you do not include reference to your definitions of
15 the different site displace -- degradation to the site
16 hydrology and changes to microclimate.

17 Can you advise me as to why that is?

18 A. Through the research of many people,
19 not only in British Columbia but in other forested
20 areas, the changes in site hydrology and changes in
21 microclimate are relatively new in understanding the
22 process. They are finding out that when you keep
23 trying to find out what is causing the problem, they
24 generally come up with another issue when they've
25 resolved the others.

1 These two we recognize as causes of
2 degradation, but they're very new as far as the
3 understanding of processes, the cause/effect
4 relationship, there's very little data to make any type
5 of a prediction of the impact, so what we have done is
6 hope that in terms of the entire site right now that we
7 are picking up the sensitivity by looking at the other
8 factors.

9 We know they exist, there is just not
10 enough information at this time. Research is underway
11 in British Columbia though looking at these specific
12 types of disturbance and degradation.

13 Q. In light of your comment, Dr. Carr,
14 just now where you say there's a lack of quantifiable
15 data for these two types of degradation, do you have an
16 opinion as to the reasonableness of using professional
17 judgment for these two types of site degradation?

18 A. Unless there is an understanding of
19 the process and some way to predict or frame your
20 professional judgment, you're not making a professional
21 judgment, you're making a guess at best.

22 And with regards to these two issues
23 there's so little available on really defining things
24 that I would say you're better off waiting until you
25 have enough to make the decision. But professional

1 judgment, if you have no framework for it even, which
2 is very limited for this time, is I don't even think a
3 reasonable way to approach the management.

4 Q. Do you have an opinion, Dr. Carr, as
5 to how one should deal with these two types of site
6 degradation; that is, site hydrology and microclimate?

7 A. I would -- at this time the approach
8 that we have taken in British Columbia is we really
9 don't consider it as a specific component of the
10 planning. We have the research under -- that's going
11 on, we're trying to monitor and determine some
12 cause/effect relationships, but until then, we set it
13 aside and concentrate on issues and possesses that are
14 more defined, that are quantified and predictable.

15 Q. Now, I'm going to ask you several
16 questions in respect of soil compaction specifically,
17 and would you turn first of all to your response to
18 Question 22 of your witness statement.

19 You list two groups of factors, the first
20 group being site factors and the second being
21 management factors, which you indicate contribute to
22 soil compaction.

23 Can you briefly explain how each of these
24 factors contribute to compaction?

25 A. I will back up a moment and say that

1 in regards to the way we have dealt with all four of
2 the key issues of soil degradation, we have tried to
3 address them both in site and management factors
4 because they're the two components as to whether or not
5 you're going to get an impact.

6 The site factors, to give you an inherent
7 capability of the site or responsiveness or sensitivity
8 of the site, that is a predicted impact, say, but
9 whether or not you realize the impact in actuality
10 depends on what you do on the ground.

11 You can take an area that is considered
12 very sensitive, manage it properly and have virtually
13 no impact, but you can take an area that is
14 non-sensitive relatively, do a very poor job of logging
15 or road building and create an outrageous amount of
16 impact. I mean, this is why we frame it this way.

17 With regards to the site factors
18 associated with soil compaction, you look at the soil
19 itself in regards to its physical structure, this gives
20 you the capability of the site to be compressed or not
21 compressed, the soil moisture, again as it relates to
22 lubricating the compacting forces and easing the
23 capability of the site to be compacted, whether or not
24 you have frozen ground, depth of snow, these indicate
25 increasing the resistance or buffering the impact of

1 compaction. And that's where these are often brought
2 into a management prescription.

3 The depth of forest floor, again, this
4 idea of a buffering capability, that if you have
5 extensive forest floor, that can act as shock
6 absorbers, say, at least for a little while.

7 With regards to the management factors,
8 this is where you, I guess you could say, make or break
9 the system, and it depends upon the applied force.
10 This would be basically the equipment, how often you're
11 running it over the ground, how many passes, size,
12 those type of issues, the scheduling which gives you
13 the opportunity to either use some of the buffering
14 capabilities, say of frozen ground or snow or, on the
15 other side, operating conditions and scheduling when an
16 area is more wet than it should be which would even
17 cause the impact to be a lot greater.

18 And then the depth of scalping or
19 blading. This pertains more to soil -- skid roads
20 construction. From our standpoint, that if you remove
21 this buffering, this cushioning of the forest floor and
22 your better soil material, the material you expose has
23 no buffering of the forest floor and you also are now
24 dealing with a very poor substrait, you're dealing
25 with, you know, soil that hasn't developed very well.

1 So that can increase -- with these
2 management factors you can either increase or decrease
3 the relative impacts on the soil.

4 Q. You've used the term soil being
5 developed. Could you explain that a little more, Dr.
6 Carr? It was in your last statement, soil development.

7 A. Soil development relates to the
8 process where your parent material becomes weathered
9 and you can develop a structure, the parent material
10 breaks down and your soil rises. It's a pedogenic
11 process.

12 The further down you are in the horizon
13 the lesser amount of development that takes place. You
14 know, if your A horizons are well weathered, a lot of
15 organic matter, if they've been worked a lot, your B
16 horizons where you can get material leaching and
17 accumulating through and that provides a structure.

18 When you get down into your C horizon or
19 parent material, you have very little development, you
20 don't really have -- you have pretty poor substrait to
21 deal with.

22 Q. And for lay people like myself, the A
23 horizon is the top level?

24 A. A horizon is top level, B would be
25 sort of your second level or layer of development, and

1 C would be your base material.

2 Q. All right, thank you.

3 Now, I note in your response to Question
4 21 on page 13 that you say:

5 "Compaction is increase in soil density."

6 And I was wondering, can you tell us,
7 does an increase in soil density have an impact on
8 forest growth and its composition?

9 A. Very much so.

10 Q. And can you tell us how this occurs
11 and in what way?

12 A. When you increase the soil density,
13 that increase -- your soil is a combination of solid
14 and pores or air mixture, and as you increase the soil
15 density you sacrifice the air, the pore component, and
16 you have a more -- you have a denser material, you have
17 one that is more resistant to root penetration, you
18 have one that does not infiltrate water well because
19 you have sacrificed your larger pores.

20 You will have -- obviously there will be
21 some problems with even the availability of nutrients
22 because now you are sort of dealing with not a well
23 drained soil, so that your nutrients be reduced as
24 opposed to be available. So it affects really the root
25 physiology and the nutrient level.

1 Q. All right. Do you have any opinion,
2 Dr. Carr, as to how well what you've just said is
3 understood, how well its relationship is understood?

4 A. Soil compaction is probably one of
5 the most studied, you know, widely studied phenomenon
6 of the soil, particularly with regards to timber
7 harvesting impacts.

8 There is a vast body of literature
9 throughout the world addressing various aspects of soil
10 compaction. A tremendous amount of work has gone into
11 trying to get a handle on these definitive -- this
12 predictive component.

13 If you increase your soil density by a
14 certain percentage, what is that going to mean in terms
15 of long-term growth, what will that mean in terms of
16 increased erosion control. So I would say soil
17 compaction rates up there with one of the heavy things
18 that's studied, one of the bigger things that have been
19 studied.

20 Q. All right. Moving on now to -- can I
21 ask you, Dr. Carr, do you have an opinion as to whether
22 site degradation can have an impact on the forest
23 ecosystem type of a site?

24 A. If you were to change -- yes, I have
25 an opinion. If you were to change the soil drastically

1 enough, then you can get a change in the species that
2 will grow there. Particularly with regards to
3 compaction some of the work that we have found with our
4 regeneration work is that if you plant, in our area
5 spruce, on compacted sites you just have terrible
6 regeneration success, most of it dies, you have little
7 yellow trees the next year and then you have little
8 sticks.

9 But we have found that on compact sites
10 lodgepole pine or pioneer species can establish and can
11 grow; doesn't grow as well as the non-compacted site,
12 but at least it will establish.

13 So if you have -- your area is affected
14 enough, you can start bringing in a change of the
15 species, the tendency going to more pioneer species as
16 opposed to more seral species.

17 Q. Moving on now to the second
18 degradation referred to in your list.

19 MR. MARTEL: Can I ask a question?

20 MR. O'LEARY: Yes.

21 MR. MARTEL: How severe -- when you talk
22 in terms of severely damaging to affect the type of
23 growth that will occur, how do you determine that,
24 simply by the fact that other trees other than the
25 original species was there? How do you determine that?

1 THE WITNESS: We have looked at it from a
2 research standpoint of comparing the regeneration grown
3 on compacted sites and off compacted sites, but a
4 number of retrogressive studies of going back -- you
5 know, of coming into an area that was logged, say, 26,
6 27 years ago and, in many cases, you can identify the
7 old skid roads and skid trails, and then you look at
8 the stocking, the trees, the volume. So it can be
9 done.

10 And then you can start determining some
11 relationship as to -- then you look at the soil and
12 going, well, this one has a density of "x" and this one
13 is "x" plus 20 per cent, and our expected volume is not
14 good and, you know, that would be the approach, and
15 there's been studies done that way.

16 MR. MARTEL: And most of the damage that
17 you're talking -- or the most severe areas for change
18 of growth would be where you had access roads and where
19 you had skid -- extreme skidding?

20 I mean, how normal is it outside of those
21 areas, for example, to cause enough compaction to force
22 the change of growth?

23 THE WITNESS: That would depend on the
24 sensitivity of the site and in the soil. Later on I
25 will talk about how we address the sensitivity issue.

1 As an example, a coarser textured soil,
2 one that's fairly got a lot of air in it, if you
3 compact it 25 per cent, increase the density by 25 per
4 cent, you still have a lot of large pores left and
5 trees can grow relatively well.

6 If you take a finer textured soil, say a
7 clay or a loamy type soil which doesn't have a lot of
8 large air pores, compact it even 10 per cent, and you
9 may be past that threshold of a tree being able to grow
10 there. So it is sort of based on the sensitivity.

11 If you take one of these sensitive soils
12 and even have one or two passes of equipment randomly
13 throughout the block, given the right conditions, one
14 pass over the area may be enough to push you past that
15 threshold.

16 So we try to bring it back to the
17 sensitivity of the site to compaction and it's not --
18 with the different soils there is a term that is called
19 a growth limiting bulk density, and that is where in
20 this increase you incur changes in tree growth. That
21 will vary from soil to soil.

22 I hope that answers your question.

23 MR. MARTEL: Yes.

24 MR. O'LEARY: Thank you.

25 Q. Turning now to soil displacement, you

1 indicate in response to Question 24 at page 15, Dr.
2 Carr, that there are a number of site factors and
3 management factors that affect soil displacement?

4 Can you explain how each of these factors
5 contribute to the susceptibility of the site to soil
6 displacement?

7 A. Yes, I can. The site factors come
8 into play -- to give you an indication how much of the
9 soil will be displaced and, say, the good soil pushed
10 over here and bad soil exposed, in a very simplistic
11 way.

12 With the slope steepness, the steeper the
13 slope and as you start operating on there, the wider
14 your right-of-way is going to be if you're building a
15 road, and it goes up very quickly, it's not just --
16 it's not a linear relationship, the steeper you go, the
17 width goes out much wider. So the steepness gives you
18 an idea of -- if I was to build a road there, how much
19 displacement would there be..

20 The slope complexity comes in the same
21 way. If you have rolling gentle terrain and yet you're
22 trying to put in a road with a reasonable alignment,
23 though you don't want to go dipping in and out of every
24 valley, your cut height, as you cut in, you're going to
25 really be gouging in some of the little bit steeper

1 areas.

2 With regards to soil depth, and this
3 really even goes to soil chemistry, it is a function
4 of, if you are removing the topsoil, you are doing
5 something that will displace soil, and it's primarily
6 some type of excavation the for roads or skid roads or
7 or landings, it's the quality of the material
8 underneath which would determine the severity of the
9 problem.

10 And if you have a very dense material
11 you're exposing, you are going to have a tremendous
12 amount of problem with the future regeneration on an
13 area without some type of rehabilitating activity.

14 If you expose a material that has a very
15 poor nutrient pool, that will define your nutrients
16 available to your next crop.

17 Q. All right. And in terms of
18 management factors, can you elaborate a little more on
19 those for us?

20 A. This comes down sort of with all of
21 them in the management practice of the harvesting
22 system that's used and how much road and access you
23 need to construct to give you this excavation or this
24 displacement function.

25 For site preparation, site preparation,

1 when it's favourable, it's a controlled disturbance,
2 you are trying to expose mineral soil in many
3 instances, the problem is if you have a site that is
4 very sensitive, once you expose the mineral soil, you
5 may not be achieving your goals.

6 You have a very poor subsoil and you do
7 some kind of mechanical site prep that removes the
8 topsoil to give you increased benefits to what you may
9 think regeneration, you may have a very poor site
10 underneath.

11 The depth of scalping, obviously the
12 deeper you go the poorer the nutrient material that
13 will be available.

14 The equipment size and pattern, this
15 would dictate again how much of the area is disposed --
16 I mean disturbed, how wide of a right-of-way do you
17 need, and that would be the same with the spacing of
18 pattern, they all sort of interlink in giving you an
19 areal extent of how much displacement will take place.

20 Q. All right, thank you. Can you tell
21 us, does soil displacement have an impact on forest
22 growth and its composition?

23 A. It does in the area of activity.
24 Obviously if you remove your growing site or you move
25 the soil and you move it six, eight, 10 feet away, the

1 residual site is going to be much poorer. So you're
2 almost -- you will have a lower nutrient pool
3 available, you may have exposed a poorer growing
4 subsoil or a denser material, so you would almost --
5 you would get almost like compaction, not by actually
6 compacting the soil, but composing a denser material.

7 It can also, again, change the
8 composition because you will not be able to possibly
9 grow the species that you want. When you go to a very
10 poor system from a good system, you're going to have
11 pioneer species that are used to, you know, a lesser
12 amount of nutrient in the soil. So that is how it
13 would change.

14 MADAM CHAIR: Excuse me, Dr. Carr. When
15 you refer to scalping, you're making a distinction
16 between removal of the topsoil and scarification where
17 there is a silvicultural purpose for exposing mineral
18 soil?

19 DR. CARR: Yes. In some instances they
20 are -- it depends on the region you're at and whether
21 you're in eastern Canada, BC, or even in Oregon or
22 Washington some of the fineness of the definitions.

23 I look at scalping as - and actually
24 scalping is used as a mechanical site prep treatment -
25 where you are trying to get controlled disturbances,

1 mixing or removing, but from my standpoint it is a
2 blading operation where it is displaced which can be a
3 mechanical site prep if that's what you want.

4 MADAM CHAIR: Mm-hmm.

5 THE WITNESS: So there are differences.
6 It's really a much more severe version of some type of
7 scarification, which is generally a mixing or
8 loosening, we really having removing or movement of the
9 soil.

10 MR. O'LEARY: Q. Thank you, Dr. Carr.
11 Moving on now to the third item on your overheads, and
12 that is soil erosion, I ask you to turn to Question 26
13 at page 16, and you were asked in relation to a
14 question about surface erosion that there are a number
15 of factors including site factors and management
16 factors.

17 I wonder if you can, once again, can go
18 through the list you have identified and elaborate a
19 little further?

20 A. I will. With regards to these site
21 factors it comes down to, I view this for erosion more
22 from almost an energy balance system where it is your
23 climate which determines the amount of rainfall that
24 you're going to get and that is -- you've got to have
25 the rainfall and the surface runoff to get surface soil

1 erosion.

2 The topography then gives you, what's the
3 energy of that going to be. If you have a gentle
4 slope, you will not have erosive energy in the system;
5 the steeper the slope, the greater the energy.

6 The soil properties relate to either the
7 degree of, or the ability of the soil to either be
8 detached or resist detachment. So that -- you know,
9 it's a resistance function there.

10 And then obviously it's the degree and
11 extent of exposure. The more area you have exposed,
12 the more erosion can take place. If you don't have the
13 exposure, you tend not to have surface erosion.

14 As far as the primary management factors,
15 they're very -- their impact or relationships are very
16 similar as previously discussed with displacement,
17 because you really don't get surface erosion until you
18 have some form of displacement in most forest systems.
19 You have to expose the mineral soil to the rain, so
20 then it would be a matter of the harvesting system, the
21 site prep, the access layout and construction, they all
22 relate to this areal extent, how much area do you
23 expose.

24 Q. All right. Could I ask you again,
25 Dr. Carr, does surface erosion or soil erosion have an

1 impact on forest growth and its composition?

2 A. It can. As you are moving the
3 nutrient and often taking it away from the site. In
4 regards to -- well, surface erosion as with many of
5 these, the degrading processes, they're not exclusive,
6 you don't always just get one.

7 To almost have soil erosion, you already
8 had to have incurred the impact of soil displacement
9 and now you have something aggravating the system, but
10 it's in the same level of removing nutrient from the
11 site.

12 Q. Thank you. Now, I'm turning to your
13 fourth site degradation that is, mass wasting, and in
14 response to Question 29 you again list a number of site
15 factors and management factors that affect mass
16 wasting.

17 Can you explain how each of these factors
18 contribute to the susceptibility of the site to mass
19 wasting?

20 A. In dealing with site factors
21 attributed to or associated with mass wasting, again
22 they're very similar in a broader sense to soil
23 erosion.

24 The climate gives you the moisture, the
25 lubricant to the system; the topography again will

1 determine the stress, the steeper the topography the
2 greater the potential for some type of mass waste; soil
3 properties is a function of the internal cohesion, some
4 soils have a lot of cohesion, they bind themselves and
5 are more resistant to movement.

6 If you take a sandy soil on steep ground,
7 you have -- there's very little, there's no particle to
8 particle cohesion. When you fool with that it tends to
9 surprise you quite often.

10 The exposure and geology are also related
11 to the inherent site properties as far as what the soil
12 is composed of, how close is the bedrock or whatever,
13 which can give you a shear plain.

14 The management factors, particularly your
15 harvesting system and your access network, really
16 relate to how much you disrupt the balance of the
17 system. If you were to deal with, on steeper slopes
18 and with your harvesting system remove your trees, a
19 big component in steeper areas of your soil's ability
20 to stay there are the roots, and it's one of the
21 problems associated with clearcuts and steeper ground,
22 that as the roots decay, you lose that binding agent
23 and the soils will often fail or can fail.

24 In such instances you might look at some
25 type of selective system to retain at least a minimum

1 level of that network.

2 As far as your access network, this would
3 again -- if you put a road in a fairly unstable area
4 you can have tremendous impact. One project on
5 Vancouver Island that I was involved with,
6 unfortunately after the fact, that from a piece of poor
7 road construction triggered a 14-hectare landslide
8 which took out the road in Port Alberni for a while,
9 many people were quite upset.

10 The intriguing thing on that particular
11 issue was I had been doing a landslide survey in an
12 area very close and we had just left and everybody
13 thought it would be rather funny if the fellows doing
14 the survey had been wiped out by one of their own
15 landslides. I wasn't really thrilled with some
16 peoples' observations, but some people thought it would
17 be nice to get rid of me.

18 Q. Dr. Carr, just going back to one of
19 the site factors identified, you referred to general
20 topography and I was curious as to whether or not you
21 have an opinion as to whether mass wasting is a
22 phenomenon that occurs only where there is steep
23 topography?

24 A. Not at all. A lot of gentle
25 topography can be unstable if you're dealing with

1 not -- your big landslides, your debris torn or
2 avalanche type of movement, but if you're looking at an
3 area that has soil creep or soil flow, a very slow
4 process that is often on gentle landscapes, if you take
5 out the toe of the slope, you remove sort of the wedge
6 holding it back, and it's quite common to have a
7 failure associated with that, particularly on what
8 would be a shallow cut slope type failure, is not
9 uncommon even on very gentle terrain.

10 Q. All right, thank you. Now, can I ask
11 you, once again, whether or not you feel mass wasting
12 has an impact on forest growth and its composition?

13 A. It has a very similar effect as
14 surface erosion. Here you have large scale-transport
15 of the soil material either off site or to some
16 location down below, and the studies -- Forestry Canada
17 has looked at the impacts of mass wasting and just what
18 component is coming back in regeneration, and they're
19 finding, like, the top third of the area basically
20 stays bare for a long time, you know, 10, 12 years; and
21 the middle zone, the middle third, they're getting some
22 type of regeneration but that's generally this pioneer
23 weedy type species, very little volume; the lower third
24 often does quite well, sometimes it does even better
25 because it has all the nutrients from up above sort of

1 being deposited, but it does have a distinct impact as
2 far as the volume that can be expected from an area and
3 also the species composition depending on where you're
4 at in relation to the mass wasting.

5 Q. Dr. Carr, you've described the
6 various changes that result from these four types of
7 site degradation. Can I ask you whether or not you
8 have an opinion as to the combined significance of
9 these impacts from a timber resource perspective?

10 A. Yes, I do. I want to refer to No. 5
11 of the package as far as the degradation, and this is
12 just some of the degradation impacts that I think can
13 be attributed or can occur to the timber resource.

14 There are, with many of these and most of
15 them, problems with regeneration of the site. You can
16 have regeneration delays and the process is still quite
17 active, or regeneration delays until -- if it's
18 available, some time until rehabilitation is undertaken
19 you may get a change, as I mentioned, in the species
20 that you want.

21 And we have now gone in British Columbia
22 to areas that have been heavily impacted by skid roads
23 and skid trails, that the new planting regime is no
24 longer -- you plant the block all in spruce, they're
25 now looking at planting spruce in your better areas and

1 pine or a couple of the companies are actually going to
2 planting cottonwoods because they happen to have
3 minimal little process, cottonwoods, on the degraded
4 sites. So you get a change from a regeneration
5 standpoint.

6 There are obviously impacts with regards
7 to seedling growth. If you can't -- if you don't have
8 the nutrients, if you don't have the capability for the
9 roots to come in, there's going to obviously be some
10 kind of impact on height growth.

11 The general assumption - it's not a
12 general assumption - much work has gone into looking at
13 trying to quantify this, some of my own research has
14 been involved in it.

15 A paper that was presented by Dr. Hank
16 Fuller from Oregon State, they have sort of compiled
17 all of the research that was done and they're finding a
18 general relationship, that for about every two per cent
19 increase in soil density they're getting a one per cent
20 decrease in seedling height.

21 And there was a very broad sweeping
22 review of all the height growth density data available.
23 In some instances it may be more, in some instances it
24 may be less, but there's a very definite relationship
25 there.

1 Where you are looking at -- where there
2 is maybe a 15 per cent decrease in soil density, by
3 reducing your operation you're looking at a potential
4 decrease of 10 per cent of your seedling height growth.
5 This obviously will reflect at some point in time to
6 reduced wood volume on your site.

7 And there haven't been unfortunately a
8 lot of long-term studies to come up quantitatively with
9 what it was. We thought we would get, you know, "x"
10 amount of wood off this site when we got "x" minus 10
11 per cent, 20 per cent. But there's been a lot of
12 long-term growth studies that have been established and
13 they have found these decreases appearing in 10, 15, 20
14 years, certain areas not growing well.

15 So there is a definite impact on the
16 long-term supply of wood from an area. If you compact
17 it or you erode it enough, you're not getting the type
18 of volumes that you expect.

19 Q. Thank you, Dr. Carr. Can I ask you
20 in relation to those numerous impacts you've indicated
21 resulting in site degradation, whether or not you feel
22 they have any effect on non-timber resources?

23 MR. FREIDIN: Well, Madam Chair, I'm just
24 wondering, I don't think the witness has been qualified
25 as an expert to talk about non-timber values. He's

1 been qualified to talk about the effect on soils and
2 timber production and that sort of thing, and I have no
3 problem with that, I don't see where his
4 qualifications -- he's not sought to be qualified in
5 that area.

6 MR. O'LEARY: Madam Chair, I tend to
7 disagree with Mr. Freidin. If you go through his CV,
8 you see that he's eminently qualified to speak to all
9 of those matters that relate to site degradation, other
10 than just trees and soil, and we can go through it
11 again, but I thought this gentleman was qualified today
12 to speak on that very issue. That was my
13 understanding, but I'm happy to go back and go through
14 the CV.

15 MADAM CHAIR: What's the purpose of your
16 question, Mr. O'Leary?

17 MR. O'LEARY: To determine whether or not
18 this expert has an opinion in respect of the impacts or
19 the effect of the site degradation on other than simply
20 trees, whether or not there are other impacts which
21 he's aware from all of the research and studies and
22 hands-on experience that he's had in British Columbia
23 and elsewhere.

24 MADAM CHAIR: Forest impacts or
25 non-forest?

1 MR. O'LEARY: Well, generally the forest,
2 but as is understood, at least to me, the difference
3 between timber resources and non-timber resources,
4 one's a tree and the other is the balance.

5 Madam Chair, soil erosion for example.
6 In his evidence-in-chief at the beginning he spoke of
7 some of the studies he was doing, he was retained by
8 Ministry of Fisheries and Oceans in respect of the
9 effect of erosion on aquatic habitat. You know, that
10 relates to a non-timber resource, as I understand the
11 definition of it.

12 He has been respected and understood as
13 being sufficiently qualified, such that the Ministry in
14 British Columbia has asked him for his expert opinion
15 in that very respect, and now Mr. Freidin is
16 questioning that.

17 MR. FREIDIN: I have no problem. I
18 understand he was hired by people who have expertise in
19 terms of concerns about the effect on the items
20 referred to on his next slide.

21 This witness may say, I have told people
22 or given advice on how stop to sedimentation or erosion
23 and, therefore, sedimentation on the aquatic
24 environment, I have told them how to go about making
25 sure they don't have landslides because they look

1 terrible on the side of the mountain.

2 That's fine, but what I'm concerned about
3 is that he not get into the area of trying to explain
4 or define what the cause/effect relationships are
5 between these various processes and these other aspects
6 of the environment. He's not a fisheries biologist,
7 he's not a wildlife biologist, he's not an expert in
8 recreational management. That's my concern.

9 MADAM CHAIR: Thank you, Mr. Freidin.

10 We will go ahead and hear Dr. Carr's
11 evidence with respect to the research that he has done
12 and what he has observed, and if we think you're giving
13 us --

14 THE WITNESS: I'm extending my
15 boundaries.

16 MADAM CHAIR: Yes. Please go ahead, Dr.
17 Carr.

18 THE WITNESS: Pushing the envelope.

19 MADAM CHAIR: Please continue, Mr.
20 O'Leary. And I would point out, Mr. O'Leary, it's a
21 couple of minutes to twelve, so if you want to think
22 about winding up your pre-lunch examination-in-chief --

23 MR. O'LEARY: It might be appropriate to
24 do that right now, Madam Chair.

25 MADAM CHAIR: Fine with the Board. Is

1 this the last question on this section?

2 THE WITNESS: It is the end of that
3 section.

4 MADAM CHAIR: All right. Why don't we
5 finish this off then.

6 MR. O'LEARY: Q. If I may.

7 A. The impacts on non-timber resources
8 and my personal work, if you want to get into it, have
9 dealt personally and on a professional level with
10 looking at impacts of water quality, particularly with
11 regards to municipal water supply in both Vancouver and
12 Victoria and I have worked with the Department of
13 Fisheries and Oceans.

14 And, I mean, in a generic manner, when
15 you have -- degradation does not just stay and affect
16 your wood supply, it affects many things through the
17 system. It can affect water quality, both from my work
18 at looking at drinking water quality and my work with
19 the Department of Fisheries and Oceans in trying to
20 look at sediment input and, you know, can we eliminate
21 it and help the fish out.

22 As far as recreation and aesthetics, I
23 have dealt with it from assisting -- that's another one
24 I've worked with landscape managers in trying to
25 minimize and buffer the impacts of site degradation

1 from visual standpoints, specific projects, one being a
2 forest road that was put in the Fraser Canyon that many
3 people were complaining about. We worked to try mask
4 or hide the buffer, the visualize impact.

5 Recreation, you know, it can be affected
6 as sort of all this other comes down. If you affect
7 your fishery resource, then you will affect the
8 fisheries chance in some areas. Personally seeing the
9 impact of the steelhead fishery in British Columbia has
10 reduced my opportunity to catch one of those little
11 devils and the habitat has been affected by
12 sedimentation.

13 Q. Is that a complete list of the
14 impact, Dr. Carr?

15 A. No, it's not a complete list by far
16 but, you know, you obviously can take a look at changes
17 of habitat as far as wildlife. There are a lot of
18 other issues that I'm not that familiar with. This is
19 sort of in a generic sense.

20 You do have off site impacts that can be
21 very substantial, of course, depending on the people
22 with regards to water quality. Having wrapped up three
23 years of looking at and dealing with the public and
24 professionals on timber harvesting operations within
25 the greater Vancouver watershed, believe me, there can

1 be a lot of impact and there's a lot of interest in
2 that issue.

3 MR. O'LEARY: That's an appropriate time
4 to break, Madam Chair.

5 MADAM CHAIR: Thank you, Mr. O'Leary. We
6 will be back at 1:30.

7 ---Luncheon recess taken at 12:05 p.m.

8 ---On resuming at 1:30 p.m.

9 MADAM CHAIR: Please be seated.

10 Please proceed, Mr. O'Leary.

11 MR. O'LEARY: Thank you, Madam Chair.

12 Q. Dr. Carr, I'm now turning the subject
13 to the causes of site degradation, and in response to
14 Question 14 at page 10 of the witness statement you
15 state that:

16 "There are aspects of all the timber
17 management activities--access,
18 harvesting, regeneration, and tending--
19 that lead to site degradation. However,
20 access and harvesting are the major
21 contributors."

22 Do you have any examples of how timber
23 management activities contribute to the four types of
24 site degradation which you've referred to earlier
25 being, compaction, displacement, surface erosion and

1 mass wasting?

2 A. Yes, I do. Maybe one tiny point of
3 clarification not that they do all but that may or have
4 the capability to cause site degradation, and sort of
5 frame it within the type of activities.

6 In access, when you have roads, your skid
7 road system, your access roads, they disturb the soil.
8 You have both soil displacement possibilities,
9 compaction and surface erosion.

10 Timber harvesting, obviously when you're
11 using ground systems, the similar sort of issues I have
12 talked about before with regards to the amount of area
13 displaced, the compaction.

14 Regeneration or renewal, not really often
15 a major fact, but one that can come into play if you're
16 dealing with mechanical site preparation in that
17 process to try to give yourself some better planting
18 spots or improve the soil as far as regeneration
19 acceptance is concerned.

20 If the equipment is used and properly, or
21 such you're often using a fairly large prime mover or
22 the cat or whatever, you still have the same options of
23 soil compaction as well if you're doing what you would
24 like to call a scarification exercise and if they get
25 kind of carried away, you can end up with excessive

1 disturbance with regards to the amount of blading.

2 And as far as tending, if you are dealing
3 with a management system where you're going to be
4 looking at some repeated entry, particularly with
5 regards to commercial thinnings using ground base
6 equipment, with repeated entry of the equipment you are
7 going to build up compaction possibilities every time
8 you go in.

9 So it can happen in all four. The main
10 causes, the main issues for the most part are with the
11 access and the timber harvesting part of the four
12 components.

13 Q. All right. Dr. Carr, I am told that
14 the proponent, the MNR, in its evidence has indicated
15 that impacts can be described in terms of frequency,
16 intensity, duration and magnitude and my question is:
17 Do these concepts apply to site degradation impacts?

18 A. You can put site degradation within
19 this context, it's not one that I'm -- all the terms
20 that I'm used to dealing with, particularly the way
21 that magnitude was used, but I can try to frame my
22 answers within these bounds.

23 Q. All right. Now, at page 9 of the
24 witness statement in response to Question 13, the
25 question reads:

1 "How wide spread is the phenomenon of
2 site degradation as a result of timber
3 activities?"

4 You state:

5 "It is a pervasive problem."

6 Can you tell me, can timber management
7 activities be carried out and have no site degradation
8 impacts whatsoever.

9 A. No, they can't. There will always be
10 some level of degradation associated with timber
11 harvesting. It's not necessarily a bad thing, it's
12 just a part of doing business, that you're going to
13 have to have access and some type of extraction.

14 It becomes a problem when you sort of
15 exceed normal levels or some type of minimum level that
16 a problem or large-scale problem is occurring, but it
17 becomes a matter, if you're going to have it, the idea
18 is to try to minimize it.

19 Q. All right. Tell me, is there any
20 variation from site to site in the frequency of
21 degraded sites within an area of operations?

22 A. Yes, there is. The frequency of
23 degraded sites will vary based upon your site and your
24 management factors. As an example, as far as, like,
25 looking at the extent, it's quite often related to the

1 type of timber harvesting system you have.

2 If you are -- this is some information
3 from baseline studies that we have conducted in British
4 Columbia. There are a number of studies that have been
5 conducted throughout the world in the literature.

6 We've found that the extent of
7 detrimental ground disturbance, and it really should be
8 potential detrimental ground disturbance, was summer
9 skidding on an average we were coming up with 15 per
10 cent of the block in landing, skid road or skid trail,
11 which -- or heavily used skid trail, normally what we
12 call degraded site.

13 With winter skidding this drops because
14 you have the frozen ground conditions the skidding
15 component is no longer as severe.

16 If you were to go to some type of a cable
17 system where you're not tramping the ground at all,
18 you're just having your landing and your main access
19 system, then you're down to like five per cent.

20 Of course, like I say, there's some
21 pretty wide ranges associated with these and the ranges
22 really reflect the type of site that was done and the
23 care of the operation.

24 24 per cent -- I personally have couple
25 of research sites where we have looked at - the kind of

1 research they were - they studies that were done where
2 we were up in the neighbourhood of 40 -- 35, 40 per
3 cent of the area in landings, skid road and skid trail.
4 So it can be extensive.

5 I have also been on sites that are really
6 well done where we're coming in -- you can hardly even
7 tell they were there except for the road and a small
8 landing. So there can be a lot of variation.

9 Q. Can you tell me, Dr. Carr, those
10 statistics or numbers you have got up there, are we to
11 understand they have been taken from the 1989 baseline
12 surveys?

13 A. Yes. There were a number of surveys
14 done in 1989. At the present time in British Columbia
15 we are -- they are compiling now the summaries of well
16 over 200 blocks that have been surveyed and I had hoped
17 to bring that, but when I called the research branch
18 they were still compiling it.

19 Q. I know you've discussed it briefly
20 earlier today, but can you tell us whether you formed
21 any opinion as to any similarity between the areas
22 where these surveys were taken and the area that is
23 under consideration here in this hearing?

24 A. These studies were taken throughout
25 the Kamloops region of both flat grounds, steep ground,

1 some of it was in the boreal, some of it was in the
2 subboreal, SBS, subboreal spruce, part of the boreal
3 forest and higher up.

4 Behind tab 9 there is another -- we have
5 the 1989-1990 results. This is beginning to deal with
6 a much larger database, a lot of information is there.

7 As of we've got now, the survey system is
8 covered, we have covered pretty well the entire
9 interior at some level of getting an idea of the type
10 of impact and the scale system, the type of systems and
11 scale of impact associated with it. Almost all of
12 these are skidding blocks. As I say, I find that given
13 the data for the cable blocks, there were not very
14 many.

15 Q. Can you tell us, Dr. Carr, do you
16 have an opinion as to whether the intensity of site
17 degradation varies?

18 A. The intensity varies as well with the
19 type of system. For example, with soil compaction, if
20 you have a type of timber harvesting system where you
21 are going over the ground quite often with, say,
22 conventional equipment. You know, the first couple of
23 passes you may not be getting a great deal of impact,
24 but if you keep repeating that four or five times, each
25 time you're getting more and more impact to a certain

1 point, then you can't get it any more. So the
2 intensity will vary, it just depends on how
3 aggressively you treat the site.

4 It may also depend upon the sensitivity
5 of your -- say, the resource that you're looking at.
6 One of the issues that we had to address with regards
7 to the greater Victoria water system is that the
8 reservoirs were very sensitive to phosphorus additions
9 from sediment, which you get sedimentation from
10 logging.

11 With the phosphorus additions, even very
12 minor additions, they have found albumin, and they have
13 a major problem with water quality that has been
14 attributed to that.

15 In Vancouver where we have probably the
16 greater capacity for more sediment to enter, we have a
17 system that is not sensitive to phosphorus and they
18 have not experienced that.

19 So you are also getting to the
20 sensitivity of what resource you're looking at.
21 There's sort of the two components there.

22 Q. Thank you. Can I ask you whether the
23 duration of site degradation impacts can be predicted?

24 A. The duration of the site impacts
25 tends to be fairly site-specific. It depends on, say,

1 the intensity of the disturbance or the degradation,
2 whether -- you know, if you've come back at five or 10
3 per cent or 20 or 30 per cent. Also, how much area
4 you've hitten, that you have affected, whether or not
5 you have any type of rehabilitation that is undertaken.
6 So the duration can vary substantially.

7 With regards to, say, soil compaction, it
8 may be a very long-ranging process. Easily -- so, you
9 know, it can be in excess of 40 to 70 years that you
10 can still detect soil compaction well after logging.

11 Q. And then I'm to understand from your
12 answer that the duration of site degradation can be
13 predicted; is that right?

14 A. Yes, it can.

15 Q. Okay. All right. Can I ask you, Dr.
16 Carr, from a forest management perspective, do you have
17 an opinion as to the significance of a failure to
18 consider or address the duration of site degradation?

19 A. Yes, I do. From a forest management
20 perspective you're really looking at the significance
21 of an impact in the future, you're dealing with a risk
22 scenario that you may have some long-term or short-term
23 risk, some long-term or short-term impact in the future
24 that if you're not addressing it now, you will be faced
25 with in the future.

1 Q. Can you tell me, can you give us any
2 examples of those risks you're referring to?

3 A. Yes. Let's take for a moment the
4 compaction risk. If you do not address compaction at
5 the time of your operation and you sort of glance it
6 by, you're running the risk, I think quite definitely,
7 that in the future you may not be getting the type of
8 timber volume off an area that you wish because of the
9 contribution of the degraded area to your overall
10 timber supply.

11 There is more of a long-term risk that
12 somewhere down the road you will come back and probably
13 after harvesting a hundred hectares and expecting the
14 wood volume in the future off the hundred, you may only
15 be getting 90 hectares worth of wood off. That will
16 cause a problem in long-run supply of timber.

17 With, say, soil erosion, here the risk is
18 greater immediately after disturbance. The
19 susceptibility of a site to erosion by, particularly
20 from road construction is greater once you disturb the
21 site and that's when you're getting the greater
22 impacts. Over time these impacts tend to lessen.

23 So there you're running a short-term risk
24 of an immediate, you know, high visibility impact,
25 compaction, looking at a long-term risk down the road.

1 You also are running the possibility in
2 only -- in not really addressing these degrading
3 factors that they can sometimes sort of be synergistic
4 or causative from a simple problem to a bigger problem.

5 This is really one of the biggest issues
6 with regards to where we have been looking at the
7 problems associated with timber harvesting and soil
8 erosion, that you have a little bit of erosion taking
9 place in the beginning and, you know, you can live with
10 the that, but over time we have found the system in
11 many -- in the work that I've done, that a culvert gets
12 blocked by annual sediment deposition, then you're not
13 dealing with the drainage of the site right, water goes
14 running down the road and we have found that it tends
15 to always go someplace you don't want it to, you know,
16 side cast area, and then you can actually trigger down
17 the road a very big effect.

18 In the Kamloops forest region, for
19 example, on what was a very gentle plateau where they
20 had been logging they had failed to effectively deal
21 with water drainage when they left the site.

22 Several -- about, I'm not sure of the exact timing, but
23 it triggered a very massive landslide that wound up
24 killing people. The Ministry went back and looked at
25 it and they found that up on this bench very nice

1 gentle area by not taking care of some microsite
2 degradation, if we can put it, this was causative and
3 they wound up with, you know, a tremendous problem and
4 the Ministry had to accept responsibility for the
5 deaths.

6 It's a very -- it's not uncommon to see
7 this type of triggering, this one just happened to get
8 a lot of profile because the deaths were involved. So
9 there's the long-term, short-term and even sometimes
10 this combination effect.

11 Q. Thank you. Dr. Carr, now moving on
12 to magnitude, can you tell me, does the magnitude of
13 the impacts caused by site degradation vary?

14 A. The magnitude does vary, not only
15 depending upon the type of degradation, but depending
16 on the scale of where you're looking at magnitude, and
17 the issue of scale is really quite important if you're
18 looking at, say, the potential losses of wood supply or
19 wood growth, loss of tree growth.

20 The magnitude, if you're looking at it on
21 a cut block basis, area of operation where you've done
22 the harvesting, it would be -- you know, you may be
23 looking at a five or 10 per cent volume loss attributed
24 to site degradation. That may or may not be
25 significant to you if you have, you know, brought it

1 into the calculation, but it is a definite loss.

2 On a timber supply area or forest
3 management unit scale, when you start adding up all
4 these fives and sevens and tens where you've been
5 operating, you can have an effect on your long-run
6 sustained yield, how much you can keep continually
7 harvesting, and if you continue on up and take all
8 these reductions or potential losses, on a provincial
9 scale it can turn out to be a very significant problem
10 to, you know, to the province if they're generating
11 wood.

12 This was the -- sort of came out in the
13 FRDA 025, BC FDRA 025, it's the Walmsley Report which
14 has been submitted as part of the evidence.

15 MADAM CHAIR: Excuse me, Dr. Carr. Do
16 you have the same situation in British Columbia that we
17 have in Ontario; and, that is, that we have no complete
18 rotation of a new forest, we have not followed
19 completely a forest that was planted or followed from
20 the time it was seeded until it was ready to be
21 harvested.

22 THE WITNESS: I see. No, actually we
23 have a similar problem I think to you, that we are
24 right now in the stage of converting the queue word,
25 these wild stands or the natural stands in many areas

1 into managed forests, so we are in the process of
2 taking wood off of uncut old growth or first cut wood
3 and we are establishing these long-term -- you know,
4 they're establishing.

5 There's very little, only in some of the
6 coastal areas in British Columbia are you getting into
7 second growth. The interior is still working off of
8 first growth, because the harvesting in the equivalent
9 areas out of Prince George or up in the Peace, which is
10 about the northern boreal areas, they're still, you
11 know, you're only looking at 20 to 40 years worth of
12 logging, they're still working on the original supply.

13 MADAM CHAIR: So the volume loss per cut
14 block that you are discussing are estimates based on
15 managed stands that are no older than 20 or 30 years.

16 THE WITNESS: 20 or 30 years.

17 MADAM CHAIR: Okay.

18 MR. O'LEARY: Q. Dr. Carr, can you tell
19 me how well the magnitude of site degradation impacts
20 are understood?

21 MADAM CHAIR: Excuse me, Mr. O'Leary,
22 just one question. What are rotation ages in British
23 Columbia for species such as lodgepole pine and spruce?

24 THE WITNESS: It depends on -- you know,
25 there's a lot of variability. I believe our - I'm

1 pulling back, I don't deal with the projection of
2 rotation ages - but I think in Prince George they're
3 looking at 125 to 150 years height rotations for, say,
4 lodgepole pine. My best guess at this time. I haven't
5 looked at -- they will often change that figure.

6 MADAM CHAIR: Go ahead, Mr. O'Leary.

7 MR. O'LEARY: Thank you. Madam Chair.

8 Q. My question is, how well understood
9 is the magnitude of site degradation impacts?

10 A. The magnitude is understood, I,
11 believe relatively well for many of the site
12 degradation impacts. There have been, you know, a wide
13 range of studies and undertakings. You could -- and as
14 far as getting this idea of the area of extent, the
15 slide I had up there earlier with the 15 and the 10 per
16 cent, there has been a large body of information
17 published not only in -- you know, throughout the
18 world, the studies that we're doing in British Columbia
19 to get a good idea -- a very solid idea of the areal
20 extent of the magnitude there.

21 You know, we're getting better through a
22 lot of the research that has been done of looking at
23 specific soil properties, how much compaction are we
24 getting and tying that directly into, at least if not
25 seedling and juvenile tree growth, and trying to make

1 projections based on equivalent heights to normal
2 stands.

3 This is also being done down in Oregon
4 and Washington. Forestry Canada now out of Edmonton
5 are beginning to take a serious look at soil
6 degradation in regards to aspen regeneration and
7 they're looking not only in northern Alberta, they're
8 looking at areas in northern Quebec, they're starting
9 to find. So it's well understood to a point, but we're
10 gaining more and more, you know, almost precision in
11 trying to make these predictions.

12 As far as looking at the erosion, you
13 know, end of things, there are some very detailed
14 watershed level experiments that have been done,
15 Coronation Creek in British Columbia has been very well
16 documented. I see a smile.

17 MR. MARTEL: We've heard about it.

18 THE WITNESS: I'm sure you have heard
19 about it and you have probably heard about the H. J.
20 Andrews and the work in the Redwood National Forest.

21 In British Columbia right now there is an
22 undertaking at a very broad scale of looking at the
23 impacts of the developments and primarily the forest
24 development, this is a big component of the Fraser
25 River watershed. Now, we're talking about a big chunk,

1 a big chunk of British Columbia, but one of the key
2 focuses will be this idea of forestry impacts spread
3 all through the area, is that having an effect, you
4 know, on the habitat and the fisheries.

5 This is being conducted under the
6 direction of Department of Fisheries and Oceans.
7 Again, they're trying to get a really good handle on a
8 wide scale of the impacts.

9 MR. O'LEARY: Q. Dr. Carr, these studies
10 you're referring to, do they relate to soil compaction,
11 soil erosion or both or neither?

12 A. Through the totally they deal with
13 soil compaction and soil erosion, some of them deal
14 with the combinations as well. So it's -- we have
15 probably some very good first cut predictions that are
16 being used to make decisions, but, you know, there are
17 researchers that are always continually trying to
18 narrow it down.

19 Q. And moving on to harvesting
20 practices, can I ask you, does the frequency, intensity
21 duration and magnitude of site degradation impacts vary
22 by the type of harvesting practice employed?

23 A. Yes, it does. We have seen a little
24 bit as far as looking at the equipment involved, but it
25 also has to relate to whether you're using, say, a

1 clearcut system verus some form of a shelterwood or
2 selective system.

3 If you going from -- you're shifting,
4 say, if you go away from clearcutting to a selective
5 type system where you're only taking in a component of
6 the stand at one time, to maintain your volumes off of
7 a given operational area you have to maintain a lot
8 more road, if you're going to try to take 300,000 cubic
9 metres and you're only taking 40 per cent of the volume
10 or whatever, you have to keep that wide open. That's
11 that much more exposure you have by having extra road
12 active and in place.

13 Then you also have the possibility with
14 these systems where you're doing repeated entry of
15 incurring repetitive -- the repetitive process of
16 compacting the site. This was one of the major
17 concerns in southern Oregon with their management
18 regime of coming in, you know, two or three times doing
19 commercial thinning. I mean, doing -- yeah, doing
20 commercial thinning, pulling it out, you know, 15 or 20
21 per cent of the wood and coming back again, that one
22 day they sat down and took a look at it and they were
23 sort of shocked that they had the potential to be
24 compacting 83 per cent of the site and they weren't
25 getting the growth responses they thought they would be

1 getting. So this repeated entry thing resulted. So
2 the system has a lot to do with it.

3 Q. Dr. Carr, you state at page 21 of the
4 witness statement in response to Question 37 that:

5 "The results of ground skidding may be
6 less noticeable and less severe on an
7 individual basis but cumulatively they
8 can be quite significant."

9 Can you expand on what you mean by this?

10 MADAM CHAIR: Are you on page 21, Mr.
11 O'Leary?

12 MR. O'LEARY: 21, yes.

13 MADAM CHAIR: Thank you.

14 MR. O'LEARY: The very last sentence of
15 that paragraph.

16 THE WITNESS: As far as answering this,
17 we have to go back to the scale, the issue that it
18 depends where you're looking.

19 Even on a cut block basis, as you cast
20 your eyes about people tend to concentrate only on
21 those big ones that jump out at you, they see the big
22 landing, they see the big road up the middle, but there
23 can be sporadic disturbances and detrimental
24 disturbances scattered throughout the block that if you
25 were to total up their impact could be quite

1 significant.

2 At sort of a forest level you would have
3 these additive effects. Sort of referring back, you're
4 picking up little losses on all your areas, but when
5 you try to plan for the future wood supply you don't
6 have the same amount of productive capacity you started
7 out with and that can have a significant impact on the
8 wood supply.

9 This was quite a bit the point of the
10 Utzig, Walmsley Report which I had mentioned, the FDRA
11 Report 025, that they were finding that when they added
12 it altogether they were coming up with estimates that
13 site degradation on an annual basis was costing British
14 Columbia \$10-million a year loss in wood values.

15 Now -- so it's not only sort of a little
16 bit here and there on a block basis, but when you start
17 piecing it together on a big scale you can wind up
18 effectively reducing your entire productive land base.

19 I mean, a key issue with us in British
20 Columbia is that you only have so much forest land
21 available and you want to try to maximize the type
22 of -- your production on it with the pressure going to
23 establish parks, to, you know, go into old growth
24 reserves, that's reducing the land base. So I mean,
25 that's an additional pressure on what productive land

1 base you have. You may be causing even -- you know,
2 aggravating the situation.

3 Q. Dr. Carr, you've made reference to a
4 report and you indicated the authors were Mr. Utzig and
5 Walmsley. Can I ask you, is that the FRDR Report 25
6 titled: Evaluation of Soil Degradation as a Factor
7 Affecting Forest Productivity in British Columbia, A
8 Problem Analysis.

9 A. Yes, it is.

10 Q. Dated March, 1988?

11 A. Yes.

12 Q. All right. Madam Chair, may we ask
13 that that be marked as an exhibit.

14 MR. HANNA: (handed)

15 MADAM CHAIR: That will be Exhibit 2046.

16 ---EXHIBIT NO. 2046: FRDR Report 25 titled:
17 Evaluation of Soil Degradation as a
18 Factor Affecting Forest Productivity in
19 British Columbia, A Problem Analysis
dated March, 1988 authored by Utzig and
Walmsley.

20 MR. O'LEARY: Q. Dr. Carr, have there
21 been any studies undertaken of which you are aware that
22 would provide some basis to determine the potential
23 significance of site degradation in Ontario?

24 A. There have been very limited -- there
25 has been a very limited amount of work, from what I

1 have been able to ascertain, done directly in regards
2 to Ontario.

3 The one major one that I've been able to
4 find is the Sherman, Mackintosh Report, which is
5 Exhibit No. 416A of looking at the productivity, where
6 they've looked specifically of a study that was looking
7 at compaction from timber harvesting operation and what
8 the potential impacts might be.

9 Another indication that there has
10 probably been at least some thought and consideration
11 with regards to Ontario is that in the Forest Ecosystem
12 Classification or the FEC manuals, the interpretation
13 manuals, for example the Northwestern Ontario FEC
14 Manual for Interpretations, on pages 318 and 321 there
15 are -- you already have now the beginnings of dealing
16 with site degradation in Ontario because there are
17 hazard keys and hazard indices relating to various soil
18 types and their susceptibility.

19 On a major scale or type of even
20 quantitative basis, I don't really know of anything
21 with regards to Ontario, but you do have the capability
22 of taking a look at -- you know, you do have the option
23 of looking at the Utzig Walmesly Report.

24 You could pull from that because it does
25 break the province down into amount of area logged on

1 various slopes, in various forest regions. You could
2 glean from that, I think, the beginnings of a much
3 broader estimate.

4 Q. Dr. Carr, can you point to us where
5 in the report you're referring to?

6 A. If you were to go, say, to page 35 of
7 the report.

8 MR. FREIDIN: Which page, I'm sorry?

9 THE WITNESS: Page 35, you can see that
10 they have broken down the percentage of area harvested
11 by system and slope class and across the various forest
12 regions.

13 If you wanted to draw out of this the
14 type of information that might be, you know, applicable
15 to Ontario, you could -- you would look at the, going
16 down the Prince Rupert interior forest region, Prince
17 George, Cariboo, and -- well, Kamloops and there's even
18 part of Nelson involved.

19 The main ones, if you wanted to take a
20 look at would be, say, the Prince George region because
21 it's very applicable, and you could sort of draw out of
22 that what the type of impacts were, and then go across
23 to find the type of systems that you were using.

24 There's a lot of data in here, but I
25 think you could probably at least get an initial start

1 of an understanding of the amount of areas involved and
2 then apply some of the -- whether it's the results from
3 the Sherman, Mackintosh or gather some very quick data,
4 there's the potential to use this type of framework.

5 Q. Dr. Carr, it is the evidence of one
6 of the witnesses presented by the MNR earlier in this
7 hearing that, and I will read you that portion of the
8 transcript that's relevant:

9 "That compaction resulting from harvest
10 operations will not effect...", probably
11 should be affect, but it says effect:

12 "...tree growth in Ontario, except on
13 severely rutted sites and very heavily
14 travelled areas on the susceptible heavy
15 clays."

16 And can I ask you whether or not you have
17 an opinion as to why or how someone would come up with
18 such an opinion in light of your evidence here today?

19 MADAM CHAIR: Mr. O'Leary, could you give
20 the Board the reference for that, please?

21 MR. O'LEARY: Yeah, I apologize. I
22 believe it's page -- the upper righthand number is 247
23 and it is Panel 10, Exhibit 416A, Volume 1.

24 MR. MARTEL: Could you repeat the
25 sentence again, please.

1 MR. O'LEARY: That compaction -- I can
2 read the entire:

3 "Mr. Rob Arnott, a soil ecologist,
4 experienced sites similar to those in
5 Ontario studied and was of the opinion
6 that compaction resulting from harvest
7 operations will not effect tree growth in
8 Ontario, except on severely rutted sites
9 and very heavily travelled areas on very
10 susceptible heavy clays."

11 Q. And my question, Dr. Carr is: Do you
12 have an opinion as to why or what would give rise to
13 such a view in light of your evidence today?

14 A. From what you have read, and I have
15 read that portion, I guess there may be several reasons
16 why.

17 There's no documented -- or evidence in
18 there, that seems to be an opinion and it's an opinion
19 that really was not any different than we encountered
20 in British Columbia, I can remember back to like 1983,
21 where we were -- I was effectively told the same thing.
22 It really depends on what you look at. It does make
23 note that it could be a problem on areas severely
24 rutted and heavily travelled areas of clay soils.

25 Well, our work has shown that it's just

1 not the extensive clays, it carries right on through
2 to, you know, many other soils are quite sensitive and
3 you may not necessarily have to be heavily travelled,
4 whatever that means in that instance.

5 part of it may also be that, you know,
6 until you really start taking a look at it many times
7 it's not something that jumps up and gets you. It's
8 really an understanding of the process and, you know, a
9 detailed look. Many people can look across a cut
10 block, you know, I don't see a lot of compaction, until
11 you start really walking the block and considering the
12 issue.

13 Within British Columbia for a long time
14 it wasn't that people really weren't concerned, it was
15 that many times in forestry activities people get very
16 sort of segmented. We have the problem over there that
17 the Timber Harvesting Branch looks at getting the trees
18 in and then it's turned over to the silviculturists who
19 have to deal with the site afterwards, and if you ask
20 somebody from timber, it's like, no, we don't have a
21 problem, we got our wood in.

22 So, you know, I can assume that there
23 was, you know, maybe a little bit of not really
24 following it. Anyway, it's obvious that -- and I
25 believe the statement was made earlier on in the

1 proceedings that somewhere, you know, obviously in
2 Ontario it is considered enough to at least start
3 developing hazard keys because they are in the
4 Ecocompany Classification Interpretation Manual.

5 So I believe that, you know, that it's a
6 change. You know, sort of if you went back into
7 British Columbia in 1983, '84 you would still have a
8 very similar answer come out.

9 MR. MARTEL: If you're moving towards
10 implementing the FECs right across Ontario over the
11 next number of years - in fact, I think we're waiting
12 for another one to come out now - what does that do in
13 the overall mitigation of that possible effects?

14 I mean, is that a long way down the road
15 to achieving what you think are the desired ways of
16 doing things?

17 THE WITNESS: I don't think it's a long
18 way down, you know, a long way down the road. We will
19 talk later, if you don't mind, about the process that
20 we go through in British Columbia and I personally feel
21 that those key -- you know, their hazard indices are
22 very similar to what we used to have, but we've gone on
23 and refined it. So it's a matter of these are, you
24 know, an initial look at it and can be used in forest
25 planning. We've just taken it a bit farther, a little

1 more site-specific and incorporated it very tightly
2 into the planning process.

3 I don't really believe it's a long way
4 down the road. I think that it's almost once you start
5 and, as this has shown, once you start looking at it
6 the momentum can build and you can accomplish a great
7 deal very quickly and get into effectively dealing, not
8 only with compaction but also erosion.

9 MR. O'LEARY: Q. Dr. Carr, can you
10 briefly review what took place, what the situation was
11 in British Columbia before site degradation was
12 accepted as a, you state, pervasive problem?

13 A. Yes, I will, and I guess I've sort of
14 began a little bit of that just momentarily a few
15 moments ago.

16 You know, when I began doing my work,
17 which was around 1978, dealing with erosion, and in
18 about 1980 getting more involved in compaction, there
19 were several other soil scientists, foresters that were
20 concerned all doing pieces and trying to get together,
21 you know, we came across an attitude that: We're
22 logging fine, get out of our way, and it was very
23 spooky at the time.

24 As I say, the interior, although there
25 are very gentle flat portions of the interior, there

1 are some very steep ones, and it would not be uncommon
2 to see Cat logging and skidder logging on 50, 60 per
3 cent of slopes which resulted in, you know, 30, 40, 50
4 per cent of the area in skid road right-of-way. Really
5 frightening things. I didn't bring pictures because
6 you would think that all logging in British Columbia
7 was terrible.

8 But, you know, there were then initial
9 sort of attempts to start restricting equipment, some
10 of the basic guidelines and, you know, consider -- sort
11 of along lines, consider not using ground based systems
12 on steep slopes, but it was still a problem of, we have
13 got to get the wood out, we have got to get it out
14 cheap, and really it was sort of an attitude: There is
15 a lot of wood out there, we're not doing anything of
16 any significance.

17 But I do know of several instances where
18 the Ministry of Forests or the Forest Service tried to
19 restrict equipment on a site, the company in question
20 said: Hey, we're the loggers, we know what we're
21 doing, you tell us what you want. And they had said:
22 Well, we would like, I believe on that operation they
23 wanted 14 per cent of the area in skid road, skid trail
24 and landing, you know, we can live with that.

25 Well, it happens to be the area of one of

1 my now long-term research plots of site degradation
2 because it's very easy to find areas to research, it
3 was about 35 to 40 per cent of the area in skid road.

4 So, you know, it was -- with the logging
5 it was a tough problem and dealing with water quality
6 issues it was, you know, to the point of being hostile
7 with the Department of Fisheries and Oceans. Very
8 aggressive. In one area the Department of Fisheries
9 and Oceans actually sent the RCMP out to charge and
10 lock up loggers who had been told by the Ministry of
11 Forests that the Ministry of Forests says: It's our
12 wood, we told you to cut it, cut it, and the company
13 was sort of stuck in the middle because if they didn't
14 cut they would lose their cutting rights. They went
15 out they were locked up.

16 The Department of Fisheries and Oceans
17 eventually charged the regional manager for the Forest
18 Service for violation of the Fisheries Act and that led
19 to a terrible set of suits and countersuits.

20 And in dealing with, like where would you
21 incorporate or undertake an erosion control activity,
22 you would only undertake one after somebody had been
23 caught and, you know, much of the damage had been
24 incurred. And this was specifically a lot of the work
25 that I started out doing, but come out fisheries was

1 very upset, can you come out and control sediment from
2 a site. As I say, it was always after the fact, after
3 the impact.

4 So it was very unfriendly and fortunately
5 we've been able to sort of deal with -- there was joint
6 committees on fisheries and forestry problem, that was
7 mainly to do with the coast, and we began to address
8 the issue of site degradation with the Ministry of
9 Forests and forest industry working together, and
10 there's been a substantial change in the type of
11 logging, the amount of planning going in. I think some
12 very, very real improvements.

13 Q. Dr. Carr, you made reference to a
14 paper by Mr. Sherman and Mackintosh which is an
15 appendix to the Ministry's Panel 10 witness statement
16 referred to as 416A.

17 I ask, have you formed an opinion as to
18 whether a person can rely upon the evidence in this
19 paper as evidence underlying a conclusion that site
20 degradation impacts are not pervasive?

21 A. No, I don't think that you could come
22 to that conclusion that they are not pervasive. It was
23 a pilot study. The magnitude of soil compaction that
24 was reported in the paper is not out of the realm of
25 the magnitude recorded in much of the other research,

1 you know, there's a high degree of comparability there.

2 So I think it is a pilot, but I think
3 it's like a red flag going up. We're sort of in the
4 same ballpark with the other areas, but it is -- it
5 could be very pervasive when you're dealing with -- I
6 was looking at the impact of skidder logging, both
7 narrow and wide tired skidders on the soil.

8 Q. Right. Well then, in your opinion,
9 as an expert on the subject, what information would be
10 necessary to demonstrate that site degradation impacts
11 are not a problem in Ontario?

12 A. You would have to really gather the
13 same information that we have looked at gathering to
14 prove that is an impact and that would involve, you
15 know, initially looking at doing some air photo type
16 surveys where you can identify distinct disturbance
17 patterns on the ground, you can see roads on air
18 photos, you can see landings, you can see skid roads,
19 depending on what you've got, you may be be able to
20 even see deep rutting.

21 Follow that up with some form of ground
22 type surveys, I would think checking the soil
23 parameters, doing bulk density testing, just to see is
24 it really, you know, how significant are the changes on
25 this 10 or 15 per cent of the land base.

1 And I also think it would be, you know,
2 wise to look at some retrospective studies, go back and
3 look at areas, the oldest logging you've got, see if
4 you can pick up differences in tree height growth 15 or
5 20 years down the road from a retrogressive standpoint
6 and look at soils there and you can build a case one
7 way or another, but if you don't have the data, if you
8 don't have anything, it's difficult to form an opinion.

9 Q. And has BC undertaken this type of
10 research?

11 A. I have talked a little bit about it
12 but, yeah, we have, and it's been quite a bit of joint
13 operation, not only with the research branches of the
14 Forest Service, Forestry Canada, but the forest
15 companies have also been very involved and very
16 interested, company participation has really grown as
17 they see the potential, if they go back and start
18 recalculating the cut for TSAs as you do, your timber
19 supply area on a regular basis, and it's like: Whoa, we
20 didn't include site degradation in our formula, you can
21 see, you know, you may see a 3, 4, 5 per cent reduction
22 in the AAC for your supply area and that can have
23 serious ramifications to a company.

24 So they've actively been cooperating, and
25 part of the cooperation has also been that there is a

1 great deal of public pressure to improve forest
2 management in British Columbia and to answer some very
3 specific questions and, you know, I guess when the
4 political will is there you can throw things into high
5 gear pretty quick.

6 Q. Do you have an estimate, Dr. Carr, of
7 what it has cost BC to develop an understanding of what
8 is referred to as this pervasive problem?

9 A. This would be a rough estimate that I
10 sort of worked through my mind, that I would guess that
11 there's well over been \$2-million worth of research on
12 site degradation in British Columbia, I would say, the
13 past decade, and that there's also a very extensive
14 ongoing program that's being conducted to further
15 refine the predictions that we've made, to further
16 refine our capability to make these predictions, to get
17 a much better understanding of the impacts.

18 Q. All right. Can you tell me, have you
19 formed an opinion as to whether or not it would be
20 necessary for Ontario to repeat all the work that has
21 been performed in British Columbia?

22 A. Having looked at it and been involved
23 all the way through it, I don't think there's a need to
24 do a lot of repetition. Much of the early key research
25 was really looking at -- was clearing up some of the

1 methodologies, you know, how do you measure, how do you
2 go out and sample so that you get a statistically valid
3 sampling system on how much disturbance and degradation
4 there is, how do you go out there and do soil testing
5 so that you can make these predictions.

6 That type of, you know, the background
7 which took us, you know, quite some time to iron out
8 the bugs, so that now we have something that's going on
9 fairly smoothly in the province with wide ranging
10 surveys and a lot of information gathering, all that's
11 really been -- has been done, so I really feel that
12 that component, for the large part, is quite
13 transferable.

14 There has also been some of my own work
15 looking at, say, from a watershed level, investigation
16 of going back and looking at a watershed and seeing
17 what some of the impacts, you know, where is erosion
18 taking place. That is actually the publication, again,
19 they had promised it to me by about December, it got
20 tied up in the Queen's printer you get bumped
21 sometimes, but it is referred to -- the projects
22 referred to in my curriculum vitae, that we now have
23 put together at least a systemic way to quantify,
24 measure at least the amount of area within a watershed
25 that's eroded, how to give it priorities, look at the

1 sediment routing and to assign some priorities to it
2 from my end of it of, how important is it and how much
3 rehabilitation do you need.

4 And that, you know, that as well has
5 been, you know, the background is there, it's just a
6 matter of going out and doing some of it.

7 The latter one for, say, a 5,000 - to
8 give you some idea - the planning, the erosion one of
9 going out and measuring and quantifying, it's about --
10 say, for a 5,000-hectare operating area, the cost was
11 right around \$7,000. A lot of it was done with air
12 photo work and some ground truthing.

13 So we've got, I feel, a lot of the
14 background information, I think we have addressed many
15 of the so-called red herrings that are thrown at you,
16 so you cannot only use the system, but focus on some
17 very specific issues quite quickly.

18 MR. O'LEARY: Madam Chair, I don't know
19 what is your intention or what is the standard on
20 Mondays, if you were inclined to take a break, we are
21 just going to move into another area. It might be
22 appropriate now.

23 MADAM CHAIR: All right. We can take our
24 break now, Mr. O'Leary.

25 Will you be finished this afternoon with

1 the your evidence-in-chief?

2 MR. O'LEARY: No. I would imagine it
3 would take up pretty much the balance of tomorrow
4 morning as well.

5 MADAM CHAIR: All right. I understand
6 that Mr. Cassidy won't be cross-examining, so that
7 leaves Ms. Seaborn and Mr. Freidin.

8 How long were you going to be, Ms.
9 Seaborn?

10 MS. SEABORN: At this point, Madam Chair,
11 subject to a telephone conversation I had this evening,
12 I have very few questions, a few minutes. I'll have to
13 wait and see what happens tomorrow morning, but in any
14 event, I will be very brief.

15 MADAM CHAIR: Mr. Freidin--

16 MR. FREIDIN: I'll still be a day.

17 MADAM CHAIR: --was your estimate.

18 MR. FREIDIN: I will still be a day.

19 Might be less.

20 MADAM CHAIR: All right. We will be back
21 in 20 minutes.

22 ---Recess taken at 2:35 p.m.

23 ---On resuming at 2:55 p.m.

24 MADAM CHAIR: Please be seated.

25 MR. O'LEARY: Sorry.

1 Q. Dr. Carr, moving now into the
2 management of site degradation, I would like to ask you
3 to turn to Question 42 in the witness statement which
4 is found at page 23, here you indicate that:

5 "Site degradation should be an important
6 and explicit factor in the
7 decision-making process regarding the
8 design of timber management activities."

9 What do you mean by an explicit factor in
10 the decision-making process?

11 A. With regard to it being an explicit
12 factor, it's very important when you're planning what
13 you're doing to consider site degradation in that it
14 can have some very major impacts; it may not, this you
15 have to sort of determine.

16 There are both on-site and off-site
17 ramifications of these impacts which we have talked a
18 little bit about earlier, that there are on-site
19 ramifications with regard to potential wood supply
20 problems, and there are off-site ramifications with
21 regards to effects on water quality and such.

22 So I feel that you have to do it, because
23 timber harvesting operations affect a very large area
24 and can have very significant - in some cases, have
25 significant impacts.

1 If you would look on page -- Tab 7 and
2 page 14.

3 Q. That is of Exhibit 2041, Madam
4 Chairman. I'm just identifying it for the purposes of
5 the record, Dr. Carr.

6 A. You will see an idealistic look at
7 how to develop timber harvesting prescriptions and plan
8 timber harvesting.

9 Now, some of this is geared at a very
10 operational level, but when you go -- you know, if you
11 look into the middle of that and to develop options and
12 define the treatments - and this is this conjunction
13 with, say, your silvicultural -- your groundrules or
14 what we use in British Columbia called preharvest
15 silvicultural prescription is what it's called - we now
16 have incorporated, among all the other factors and,
17 these are -- you know, there are economic
18 considerations in timber supply, seasonal
19 considerations as to when you log, stand
20 characteristics, all of this, but it's important and
21 what we have -- we have added to the system now, you
22 know, you will address the site degradation issue in
23 there.

24 And I think that this type of approach is
25 what you really have to look at in dealing with the

1 timber supply or forest management planning, either
2 one, because of these impacts.

3 Q. Dr. Carr, have you formed an opinion
4 as to what point in the timber management planning
5 process site degradation impacts need to be considered?

6 A. I feel that site degradation impacts
7 should be considered basically at all levels of the
8 planning procedure. We won't worry about them.

9 At the provincial level, and the way
10 we're addressing it in British Columbia, is really
11 setting up some guidelines -- not guidelines, standards
12 to be achieved.

13 Effectively the Crown is saying we want
14 to maximize and it is the Crown's mandate to maximize,
15 conserve and protect the forest resource, that they are
16 stating how much impacts are necessary and that they
17 really don't want it going -- they will not allow any
18 more outside normal area of operation. So that you're
19 looking at it from a provincial perspective.

20 As you get closer, say, the next level
21 down of dealing with in a timber supply area or a
22 forest management unit, they're fairly comparable in
23 terms -- that's my understanding, you take a look at it
24 with regards to the inclusion when you're developing
25 your long-run sustained yield calculations, that as

1 this land that you're cutting is eventually brought
2 back into the rotation or brought back into production,
3 it becomes part of your wood supply, there are -- you
4 are incurring these long-term impacts.

5 So you can't assume that just because you
6 had a hundred hectares there before with productive
7 ground you have a hundred now, particularly when you
8 know that there may be some impacts, and so it's in a
9 long-run sustained yield calculation.

10 At a development plan or site -- you
11 know, obviously when you're starting to get into a
12 development and operations there you're going to be
13 far more specific and looking at site degradation more
14 almost like on an individual basis. You can work your
15 way down to the level of specificity, but it's always,
16 you know, to be there. I don't think you can get away
17 from it in trying to address timber harvesting.

18 Q. Dr. Carr, at the timber management
19 planning stage what, in your opinion, is required to
20 manage site degradation impacts?

21 A. At the timber management planning
22 stage I feel that there are a number of elements that
23 you have to have to address site degradation. You
24 really have to have some type of goal, you have to have
25 an objective, specific target say of allowable

1 disturbance verus that which is felt to be excessive.

2 You need to have some level of data with regardings to
3 the area of operation, you need to have a system to
4 look at that data or come out of that to determining a
5 sensitivity of an area.

6 From that -- you know, when you have the
7 sensitivity then, you know, it just flows through, then
8 you can start looking at the prescription process. You
9 know, if you would hopefully have some cause and effect
10 or some type of predictive relationships that you've
11 established with regards to a certain sensitivity and
12 effect, say, compaction on -- as put in there,
13 compaction on the sensitive clay soils. Well then,
14 that's in there because you have identified these
15 specific clay -- you know, sites as sensitive and you
16 know that compaction is bad.

17 You would then have to -- you can carry
18 through and part of what the field guide behind Tab 7
19 is about is to incorporate this into developing an
20 effective prescription, one that meets your management
21 objectives but also meets your site degradation
22 objectives.

23 You would have to compare the options, as
24 far as the risks, to the resources that you have
25 available that you may affect and their value, and then

1 to develop the prescription.

2 So there's a series of things that are
3 available, sort of the direction, the objective, the
4 data needs, working your way down to some type of
5 sensitivity assessment and then developing the
6 prescription.

7 Q. Dr. Carr, one of the elements you've
8 just indicated is necessary at the timber management
9 planning stage is data, and I was wondering if you can
10 tell us what data is required to manage site
11 degradation impacts?

12 A. The data necessary to manage site
13 degradation impacts relates back to the scale, the how,
14 where you're looking at it. On a forest management
15 level basis, you know, it would depend upon -- let me
16 back up.

17 It has to do with the scale and what type
18 of resolution you want and, you know, where you're at
19 in the system, but at a forest management level basis
20 it's quite easy to, I think, to look at terrain maps,
21 ecosystem maps, you know, that information that is
22 available, you know, over a fairly broad homogeneous
23 area which, appears that you have, to really come out
24 with a first cut of sensitivity.

25 In British Columbia and one of the first

1 things -- one of the first things usually done within
2 calculating an area of timber supply area plan is they
3 determine the area of operabilty, and in that they
4 identify environmentally sensitive areas called ESA
5 mapping and there are a set of criteria and conditions,
6 but these are just using air photo work, general
7 terrain, soils information, areas that are sort of red
8 flagged that we have a sensitive area we may or may not
9 be able to harvest that, but we may have to harvest
10 with certain constraints. And, as I say, that is done
11 like a TSA level.

12 As you work your way down, getting into
13 developing individual silvicultural prescriptions or
14 ground rules, your database can improve and with that
15 you can start going, you know, to more detailed soils
16 information because, you know, you have -- the
17 ecological system ties in much closer with a specific
18 soil texture of an area or, you know, the terrain or
19 topography or the terrain, these things are inherent in
20 the ecosystem classification.

21 And then when you get down to your
22 individual cut block, you can go through a pre-site
23 visit and further refine the information needed.

24 Q. And flowing out of one of your
25 comments, Dr. Carr, can you tell us what are the

1 criteria that underly designation of an area in British
2 Columbia as an environmentally sensitive area. You
3 used the acronym ESA.

4 A. I'm not personally involved in ESA
5 mapping or the fine rules associated with it, my
6 coauthor on much of this work, Dr. Lewis, has done far
7 more of this than I, so I really couldn't give you the
8 specifics of what determine an environmentally
9 sensitive area.

10 They do include it looking at using
11 broader terrain topography information, areas that
12 could have very significant impact on and off, you
13 know, a water resource, a specific habitat type, major
14 impacts on, say, soil compaction there.

15 The ESA mapping, there are several levels
16 of it depending on whether or not it's to be taken out
17 totally but many times you have, like, a low level ESA
18 mapping which says very sensitive, cannot be logged by
19 conventional means but may be harvested by, you know,
20 special criteria.

21 So, you know, that's as much as I could
22 really give you on that.

23 Q. All right.

24 A. As far as procedure.

25 Q. Now, you said just a short while ago

1 that one of the other elements required at the timber
2 management planning stage to manage site degradation
3 impacts and you it indicated prediction of site
4 sensitivity was one area.

5 Can you tell me, how is data used to
6 predict site sensitivity?

7 A. The field guide that I have
8 referenced behind Tab 7 represents a compilation of
9 material that we have put together to determine site
10 sensitivity at a cut block area where we do in British
11 Columbia our preharvest assessment and prescription.

12 You could -- as I say, you know, if you
13 have reasonable enough ecosystem information on a
14 broader scale you could come into there and use this
15 sensitivity process and then refine it later on. But
16 the procedure that -- and where we deal with it is at a
17 cut block basis.

18 Q. Dr. Carr, have you formed an opinion
19 as to the level of concern in British Columbia about
20 site degradation?

21 A. Obviously I have, that -- and I've
22 mentioned this earlier to the Board, that the level of
23 concern in British Columbia has grown markedly in the
24 past few years. From some of the early research and
25 early workshops looking at site degradation, it

1 became -- probably hit the first level of real high
2 concern in 1988 when the Ministry of Forests decided to
3 issue site degradation guidelines or standards - we
4 called them guidelines back then - but they were
5 enforcable standards to restrict the amount of
6 potentially detrimental degradation on an area.

7 Now, in '88 there was a set of
8 guidelines -- or standards that were developed
9 internally within the Ministry of Forests and when it
10 was about ready to be issued the industry sort of went:
11 We've never seen this, what is the basis for this, we
12 don't even know if we can -- you know, where did they
13 come from.

14 So they pulled back at that time and the
15 Interior Forest Harvesting Council was struck with the
16 Deputy Minister of Forests as the head, the head of the
17 council forest industries, and various members, and
18 they were to come up with a process or guideline -- you
19 know, these standards, you know, to define standards.

20 It had already come down from the chief
21 forester that standards should be established, that it
22 was obviously a problem he felt from the work that many
23 people had done and was one that there was a political
24 push, you know, mandate to deal with.

25 The Interior Forest Harvesting Council,

1 as I said, was a joint ministry, industry group that
2 sat down and sort of thrashed out the development of
3 specific standards for site disturbance, and they are
4 at a provincial level, but the standards -- there are
5 standards for the interior and there are also standards
6 that are soon to be put forth for the coast because
7 they represent very radically different systems.

8 Q. Dr. Carr, you made mention to the
9 Interior Forest Harvesting Council. Can you tell us
10 what that council was composed of, who sat on it and
11 who was involved?

12 A. The council was a fluctuating group
13 at types because it took several years for them to
14 finally agree to something. The main members - and
15 it's been a while since I have dealt with them
16 directly - you had the Deputy Minister of Forests, you
17 had the head of the council of forest industries, you
18 had the head of the Forest Research Institute of Canada
19 in Vancouver, there were two regional managers from --
20 I believe I they shifted, they were I think Kamloops
21 and Prince George, there were also members from two of
22 the major forest companies.

23 Underneath them they had a technical
24 advisor, technical advisor committee, Interior Forest
25 Harvesting Council TAC, and that consisted of members

1 of both research and operations from the companies and
2 from the Ministry of Forests, Forestry Canada, FERIC,
3 the Forest Research Engineering Institute of Canada.
4 So you had both administrators and you had a number of
5 advisors.

6 Q. All right. Dr. Carr, can you tell
7 us, have maximum site degradation levels been set in
8 British Columbia?

9 A. For the interior regions of British
10 Columbia maximum levels have been set.

11 Q. All right. Can you give us some
12 information as to how they were decided upon, how they
13 were set?

14 A. There was a great deal of discussions
15 and, as I said, I think it took two years of the
16 Interior Forest Harvesting Council dealing with the
17 issue to come forth with an interim set of
18 guidelines -- of standards that they felt were good
19 enough to start with.

20 One of the criteria with the interim
21 guidelines or the interim standards - you will have to
22 excuse me, when I say guidelines and standards, we've
23 have always called guidelines, to us it's an
24 enforcaable standard.

25 They were issued in May of 1990 to be

1 field tested for a two-year period, at which time final
2 standards would be put forth.

3 Q. All right. Can you tell us, what are
4 the levels that have been set, Dr. Carr?

5 A. The levels that have been set are
6 tied into site sensitivity. The specific numbers at
7 this time for low and moderate sensitivity sites, 19
8 per cent; for high sensitivity sites, 9 per cent; and
9 for very high sensitivity sites, 4 per cent of the
10 area, and it's very specific as to what is included.

11 This includes the amount of area in
12 landings or decking area, the amount of area in your
13 bladed skid roads, as well as the amount of area in
14 what is called a heavily impacted skid trail which
15 tends to be your rutting areas where you can see
16 obvious tracks of a vehicle crossing the site.

17 Q. All right. Can you explain for us
18 why there is this range in levels and not just one?

19 A. The adoption of the sensitivity
20 component really came out of the work that Dr. Lewis
21 and I had been doing. We had initially developed these
22 site sensitivity assessment and the prescription
23 procedures that are in Tab 7 as a planning tool, as an
24 aid to the forest planner.

25 The committee saw this as a very good

1 tie-in with their guidelines. Because, you know, as I
2 discussed, some sites are more sensitive than others
3 and can withstand more of a specific impact of others,
4 and that's addressed in, you know, this ranging.

5 It was not a licence to go crazy. If
6 conventional, you know, logging in, say, one of the
7 forest districts was generally coming up with 16 per
8 cent of the area in landing, skid road and skid trail,
9 you couldn't now go -- well, the guidelines say 19 and
10 I have more latitude than allowed me, there was a
11 specific clause within that, you know, this is not a
12 licence to go out there, these are maximum levels that
13 can be, you know, on a localized basis be adjusted
14 down.

15 Q. All right. Dr. Carr, since these
16 levels have been set, have you formed any opinion as to
17 the need to refine them?

18 A. I do think that there will be and
19 that there should be refinement. Part of the component
20 of being interim with any type of regulation, you have
21 to see: Is it workable, is it realistic and
22 achievable, and from my understanding and knowing what
23 went on in the timber harvesting -- Interior Timber
24 Harvesting Council, you had one group putting forth
25 issue papers that said: We think we have to have 25

1 per cent of the land, and you had other groups going:

2 I think 5 or 6 per cent is too much.

3 So I'm sure you can imagine the amount of
4 wrangling that went on, and that's when they came up
5 with the 19, 19, 9 and 4. It was like: Well, we think
6 we can live with that, let's see how it goes.

7 Since they have been issued under an
8 interim basis we've been giving at the workshops, but
9 they are also, as I mentioned earlier, a large number
10 of surveys were done and many of them were being
11 conducted under the direct -- you know, direction of
12 the Interior Forest Harvesting Council to gather data:
13 Are these levels achievable, is it realistic.

14 I mean, there is no sense to have a
15 standard if you can't meet it within a reasonable level
16 of operation or not -- you're not going to get
17 everybody to shift, in our condition, going from, you
18 know, narrow tired skidders to wide tired skidders,
19 there's a huge cost involved. So, I mean, you know,
20 that was built into the system.

21 The surveys, some of which I talked a
22 little bit about, if you were to look behind Tab, I
23 believe Tab 9 of the document before you, there is some
24 more information with regards to the 1989-1990 results.
25 And, as I say, at the present time there's a much

1 bigger compilation of all the surveys that have been
2 done.

3 It appears quite likely that there will
4 be an adjustment down before the final guidelines --
5 before the final standards are put forth, the reason
6 being that in looking and going out and assessing only
7 those sites that are considered in a broad range good
8 logging, comparable standards, they're coming in far
9 below, on your low/moderate sites than the 19, they're
10 coming, you know, 12, 13 per cent for summer ground
11 skidding at a maximum. You know, you don't really need
12 the 19.

13 So I think from preliminary discussions
14 that it's going to move down a little bit to something
15 in the neighbourhood of 15 per cent at the top end.

16 And then the last that I heard it would
17 be 15, 12, 9 and 4, but when these things get into the
18 committee they may be 15, 15, 9 and 4, but I think
19 there's going to be a move down.

20 The guidelines were shown -- standards
21 were shown to be achievable with good planning and
22 under conventional logging.

23 MADAM CHAIR: But also, Dr. Carr, you
24 didn't know at that point that 12 or 13 per cent is
25 what -- was the area that was being used for landings,

1 skid roads and skid trails anyway?

2 THE WITNESS: We had a very good idea
3 from many of the preliminary studies that went into it.
4 The research and the assessment of site disturbance has
5 been going on for close to a decade now, not at the
6 level and, you know, the numbers, but there were some
7 very crude, you know, the early studies that we had,
8 some of my work, some of the work from Dick Smith from
9 the Forestry Canada, they had -- they were giving
10 frames pretty close, and there was lot of work that was
11 with FERIC, Forest Engineering Research Institute of
12 Canada, had a big role in looking at equipment and
13 machine capability and what they knew by their studies.

14 So, yeah, I do agree with you at first
15 when they set the 19, 19, 9 and 4 it was a first cut at
16 it and since then we've increased our understanding and
17 they may well go down.

18 MADAM CHAIR: Of what per cent do
19 landings-- landings are what per cent of the area?

20 THE WITNESS: I thank you for asking that
21 because I had sort of -- I deal with this issue a lot
22 and I often forget. Landings are set, depending on the
23 area, they are generally 3, 4 or 5 per cent, you know,
24 there are many factors involved.

25 The standards actually set a maximum of 5

1 per cent of the area in landings. So of your 19 you
2 can have a maximum of 5 five per cent landing; the 14
3 would be distributed between your skid road and your
4 heavily impacted skid trails.

5 Landings were addressed sort of
6 separately since they are very large, extensive, you
7 know, localized areas, you know, they can be .5 to, you
8 know, a hectare in size if they wish.

9 MR. O'LEARY: Q. Dr. Carr, is it
10 possible at the timber management planning level to
11 predict future losses in wood volume that are likely to
12 be incurred as a result of site degradation under
13 varying silvicultural prescriptions?

14 A. Yes, I do believe that you can make
15 some estimate of what the impacts could be on your
16 long-run sustained yield.

17 Of course, the position is going to
18 depend upon your database, as it always is, but by
19 knowing even at your forest management, you know,
20 planning level, within that you have identified
21 ecosystems and the associated type of sensitivity and
22 in that regard you know the type of logging systems
23 that you have available, and for British Columbia we
24 have a very good idea of the amount of -- if you take
25 logging system A, this is the type of disturbance level

1 you will get, and if you take B, you will have this
2 one.

3 And you could -- and also now we use,
4 based on our early research, our current prediction of
5 volume losses associated with landings is a hundred per
6 cent volume loss at -- for the rotation and for your
7 skid roads and your heavily impacted skid trails a 40
8 per cent volume loss, and you could factor that in and
9 assume that you meet your maximum, you're going to be
10 operating at your maximum level of, you know,
11 difference in disturbance and you could prepare a
12 number of options, you know, through that type of
13 system and it could be developed.

14 MADAM CHAIR: Does that take into account
15 though that you might regenerate, you might do some
16 silvicultural treatment of landings and...

17 DR. CARR: You could actually build that
18 in there because you would have an estimate of how much
19 area is in landing.

20 I mean, that would be part of the
21 silvicultural prescription, would be to rehabilitate
22 the landing, and we have -- much of my work and several
23 others, we have looked extensively at: How do you deal
24 with the soil once it's compacted, can you bring it
25 back into productivity and depending on the site we've

1 had, you know, we feel that we can.

2 I can go through this procedure, I
3 planned to address them a little bit later, but you can
4 even build that in so, you know, for landings some is 5
5 per cent, you can say within your -- you know, we will
6 do rehabilitation and, based on our results from our
7 landing rehabilitation trials, we can expect at least
8 60 or 70 per cent recovery there. You could bring that
9 back in.

10 It would actually give an impetus if you
11 were taking me in doubt that they were created, it
12 would give an impetus to: Let's put it back in. It
13 would be a great way to give a lot of strong push to
14 rehabilitation.

15 Q. Dr. Carr, is the volume loss that you
16 refer to currently taken into account in British
17 Columbia's wood supply forecasting?

18 A. At the present time the impacts from
19 a prediction standpoint of site degradation are now
20 beginning to be included in the long-run sustained
21 yield calculations.

22 The Province of British Columbia is
23 fairly large and as it turned out each timber supply
24 area, they generally have some different little
25 interpretations.

1 The North Townsend timber supply area
2 where you have a number of forests are very progressive
3 and they have been for a long time, they have always
4 included a 2 per cent factor to site degradation in
5 their calculations.

6 The Merritt timber supply area, which
7 happens to be in the same forest region but a different
8 group of districts together, they had never included
9 any factor for degradation.

10 Before I left I wanted to try to sort of
11 see what was happening with this type of issue and the
12 Merritt Forest -- Merritt timber supply area is
13 currently redoing their -- they're up for their TSA
14 calculation and they are now including a site
15 degradation component.

16 And it appears that, as I say, they've
17 included it before, all of a sudden you're now
18 effectively taking productivity out of the system,
19 There may be in the neighbourhood of a 4 or 5 per cent
20 decrease in the long-run sustained yield from that
21 area, which would then have a reflected impact on the
22 AAC and everybody's cut. So it is being -- it's being
23 incorporated.

24 The interesting thing is now that it is
25 truly being incorporated, the point you brought up

1 about rehabilitation, now everybody's going: Well,
2 let's not take out the full thing, we're going to rehab
3 everything and which is wonderful from my standpoint,
4 that they will begin to -- it has been a very good spur
5 to stop -- you know, plan better, you know, we are
6 going to do better, let's stop using these big numbers,
7 let's scale it down.

8 So it's having a very quick -- I think
9 very quick impact on the forest practices that are
10 being undertaken.

11 Q. Dr. Carr, if I can turn you now to
12 Tab 7 of Exhibit 2041, which is the document entitled:
13 Developing Timber Harvesting Prescriptions to Minimize
14 Site Degradation, it appears that you were one of the
15 authors responsible for that document together with
16 Terrance Lewis.

17 Can I ask you to take us briefly through
18 that document, through the salient portions of this
19 field guide and explain how the process would work for
20 a specific site, outlining the data that would be
21 required and how it would typically be acquired.

22 MADAM CHAIR: Excuse me, where are we Mr.
23 O'Leary?

24 MR. O'LEARY: I'm at Tab 7, Madam Chair,
25 of the exhibit which contained his witness statement.

1 MADAM CHAIR: Page...?

2 MR. O'LEARY: I am asking Dr. Carr to
3 point out the salient portions of that document and
4 explain to us how the process would work for a specific
5 site, indicating the data that would be required and
6 how long it would typically -- how one would typically
7 obtain that information.

8 THE WITNESS: I will go through this very
9 quickly. I would have to just let you know that this
10 is a two-day workshop that we have put on for the
11 industry and you can, you know, maybe read through it
12 in more detail at some point in time, but I would
13 hopefully provide you with a flavour of the process and
14 how it's being -- you know, and how it's used.

15 The obvious part of it is, you know, is
16 the objective, and the objective is to minimize the site
17 disturbance and potentially degrading disturbance from
18 timber harvesting operations and, as I said, this
19 concept was initially put forth as a planning tool.

20 And if you go to what is page -- let me
21 sort of frame where this takes place in British
22 Columbia.

23 Now, that there are guidelines --
24 standards, it's not until you get down to the
25 silvicultural prescription level that you go through

1 this type of a detailed process. For us the
2 silvicultural prescription, preharvest silvicultural
3 prescription process is on an individual cut block
4 basis and it's done prior to the timber harvesting
5 operation. It has to be put up for review; it's not
6 unlike, as I see, your silvicultural ground rules, but
7 instead of just doing it at a five-year plan, this is
8 much more comparable to us doing it at a one-year or
9 annual work schedule process, to give you some idea of
10 where this comes in.

11 One of the components of the preharvest
12 silvicultural prescription is the determination of site
13 sensitivity and, just for information, the
14 silvicultural prescription in British Columbia is a
15 legal document that has to be signed and sealed by
16 a registered professional forester and he is responsible
17 for the information contained and for the
18 implementation of that procedure.

19 If there are errors, as a professional
20 forester, he could be liable to some type of - I won't
21 say punishment - but there's the potential there that
22 there's at least a high degree of responsibility for
23 their undertaking.

24 Each proposed cut block is then visited
25 and it is tied into our ecological system because the

1 ecological system determines, you know, quite a bit of
2 your harvesting practice, your long-term silvicultural
3 prescriptions or the type of stocking you want later or
4 where you're going.

5 What we have done, in doing this we have
6 taken the information that's normally collected at that
7 stage and we have pulled out certain components to
8 create the sensitivity document.

9 The sensitivity form that you see on page
10 3 of the field guide is really a reorganization, just
11 for our purposes, of the data that is normally
12 collected. You have basic climate data, you have basic
13 ecosystem data, terrain data is collected as part of
14 the, you know, site evaluation, as well as, you know, a
15 level of soil information.

16 And then what we present here is: How do
17 you take information that's already gathered. We
18 didn't want to add anything to the process, we wanted
19 to take existing information and come up with a
20 sensitivity.

21 If you would flip over to pages 4 and 5,
22 this deals with our way of -- our index of soil
23 compaction hazard, and it's specifically on page 5.
24 The rating that you see on the lefthand said is tied
25 into soil texture. It is not unlike the rating -- the

1 compaction hazard rating that is in the ecosystem --
2 the Northwest Ontario FEC document, the interpretation
3 document that I had mentioned earlier where you have --
4 your soil has an inherent level of sensitivity to
5 compaction; your clays, your clay loams are very
6 sensitive, your coarse materials, your sands, your
7 gravelly sands, very low sensitivity, and that's where
8 you would get the sensitivity rating for compaction.
9 It is very parallel to what you have in Ontario right
10 now.

11 The information that is on the righthand
12 of that table called impact modifiers is for the
13 planning aspect because, as I say, there is a planning
14 manual. It's trying to point out to the field
15 forester, these are some of the options I have in
16 starting to schedule my operations.

17 If I'm in a very high sensitivity site
18 from compaction, well, how can I not incur so much
19 damage. You would look over there and say: Well, if I
20 have -- you know, snow or frozen ground. So
21 effectively you're declaring almost right then that
22 you're going to look pretty close at a winter
23 operation. That is the first of the sensitivities.

24 The second key set of information is on
25 pages 6 and 7 and has to do with the soil displacement

1 hazard key.

2 MR. O'LEARY: Q. Dr. Carr, I'm was
3 wondering if you can help us. Just going back to page
4 5 there's a box that is referred to on page 5 as
5 surface condition factors. Can you tell us a little
6 more about that?

7 A. That is included -- surface condition
8 factors are included as well as part of the impact
9 modifiers. It has been shown that if you have a very
10 deep -- if you have a deep or very fine browse forest
11 floor that that can give you quite a bit of buffering
12 capability, or if you have slash and a fibrous forest
13 floor, three, four, five passes of a piece of equipment
14 may not give you a whole lot of compaction, so
15 obviously you don't want to go, you know, pulling that
16 out and removing that.

17 So the tendency would be for us to ask
18 them not to go and blade with skid roads but to rely on
19 overlay and skidding. The scalping is just the
20 opposite, you have removed that component

21 Q. Now, just for the sake again of some
22 of us lay people, where it indicates under impact
23 modifiers versus frozen ground you've got 51 centimetres
24 plus, looks like a minus two classes. Am I reading
25 that correctly?

1 A. Yes, it says minus two classes.

2 Q. And the result is that there would be
3 a decrease in the class under hazard rating by --

4 A. No.

5 Q. No. All right.

6 A. It's something that when we redo the
7 guides, which are about ready -- we're looking at a
8 little editing, we will make that a bit more clear.

9 As I say, these are impact modifiers and
10 in the lecture, because the people that have this will
11 have taken the workshop, it's quite specific that we
12 deal initially with the inherent sensitivity of the
13 site and that sensitivity is the rating.

14 The modifiers are there just to help
15 somebody started thinking, how do I deal with this, and
16 we are trying to give a rating that if you have 51
17 centimetres plus of frozen ground, you know, and you
18 start -- you know, the idea being if you're operating
19 on the site, then if you were in a high sensitivity
20 area you would hopefully be getting an impact
21 equivalent to a low sensitivity site of having operated
22 on the area.

23 So it's a planning tool just, you know,
24 this whole thing is a planning -- it's just not
25 sensitivity but sensitivity and planning. We try to

1 provide some aids to the planner. This is where it
2 comes in. The inherent -- the initial sensitivity
3 is -- the sensitivity is the hazard rating.

4 Q. Thank you. Sorry to interrupt.

5 A. I should add that something, and it's
6 is probably very applicable to Ontario, that this key
7 and all of our keys are geared at looking more at the
8 impacts on the mineral soil, and when you're dealing
9 with organic soils where you have very, deep organic
10 horizons, very -- sort of your wet sites of organic
11 horizon over 40, I believe it's about 40 centimetres,
12 at that time you would initially -- you would go
13 exclusively to the soil displacement key because that
14 will be the factor. You don't always have to go to
15 every one of these because some of them will be come
16 out very quickly. That one specific hazard will be the
17 one that you'll manage around.

18 If you would turn quickly to page 7, that
19 is a soil displacement hazard key - the holes at the
20 top may block you - and this is where we look at the
21 site factors that, you know, I addressed earlier this
22 morning of the slope in both, you know, the steepness
23 and the complexity as well as the subsoil material.

24 Now, this key and all the others, we
25 develop a point system where you assign a number of

1 points and then add them up and come up with a rating
2 at the end.

3 One of the things on the data form on
4 page 3 under hazard rating, we have little slots lined
5 out for people to use in the field, they may fill in
6 the blank to make sure they deal with all the factors.

7 So we have tried to make this a very easy
8 tool, not only for foresters, but technical level
9 people that are out in the field doing the preharvest
10 silvicultural prescriptions, or at least gathering the
11 initial data.

12 There are three components to the soil
13 displacement key, the first being the slope gradings.
14 Obviously the steeper the ground, as I explained this
15 morning, all these sort of ask leading questions: If
16 I'm operating on this area and I'm blading, creating
17 road, how much area am I exmposing. And we have points
18 assigned to the slope gradient, and it's not like just
19 if you go from 5 to, say, 15 to 30 per cent slope, you
20 don't just double the points, it's actually
21 exponential.

22 And that is just related, that as you get
23 on steeper ground it goes up very quickly how wide and
24 much area you're going to disturb. So that relates
25 to -- both the area and the complexity both relate to

1 the amount of area you're going to expose, then the
2 substrait condition, you pick what is the most limiting
3 of these and this really gives you what is the
4 characteristic of the material that I'm exposing, and
5 we have definitions for what we consider an
6 unfavourable subsoil, and that is basically a very,
7 very nutrient poor material.

8 There are areas in British Columbia where
9 we have problems with carbonate soils, soils that when
10 you expose them have a lot of problems with regards to
11 regeneration. So obviously the closer they are to the
12 surface the more problem you are going to have from
13 long-term regeneration, seepage and bedrock both become
14 very limiting, the closer they are, it's just a
15 reflection of how much growing space do you have.

16 So you would add up the various points
17 and then come down into, you know, a very
18 straightforward hazard rating for soil displacement.

19 If you would go to 8 and 9, the next set
20 of pages, this is surface erosion hazard key. Again,
21 it's an additive system. There are a number of
22 definitions on the bottom of page 8 that we use. The
23 first is to get an indication of the climate, or the
24 rainfall factor is what we use, the climate, how much
25 precipitation you are going to get, or are you getting

1 a lot of not only rain but rain and snow.

2 And what we have adopted is the R value
3 or the R factor that is associated with the universal
4 soil loss equation and that is a very widely used
5 equation in one form or another to deal with soil
6 erosion, and we have, with the help of Agriculture
7 Canada, taken the R values that have been calculated
8 for British Columbia and developed a correlation
9 between rainfall and our ecosystem classifications.

10 So you don't really have to know the R
11 value. We have provided in the back, I guess they
12 start on page 28 through. For each forest region and
13 each of our ecosystem association of variance, we have
14 already put them into an R value, so when you're out
15 there doing it, if you know you're in the subboreal
16 spruce -- say, for the Kamloops forest region, if
17 you're in the subboreal spruce, the DH which is the -
18 they changed the system - but I believe it's the, say,
19 the DW, which is I believe it's wet cold, I can't
20 remember offhand, but you would have that information
21 already, you would just go -- from the previous
22 ecosystem classification, you would pull out of there
23 3, 6 or 9 points.

24 Topography are in very broad groups,
25 you're looking at slope gradients of 0-15, 16-30, 31-60

1 and such. Obviously the steeper the slope the
2 potential for much greater energy to be developed.

3 We have a length uniformity factor, again
4 related to topography. The longer the slope, the more
5 uniform -- the probability that if you put a road in
6 there you're going to have a long gradient, a long run
7 of energy. As I say, these are just indices asking
8 questions, what if I put these in.

9 Depth to restricting layer. The surface
10 soil -- the surface factors that you would look at, or
11 the soil factors, you have the restricting layer that
12 gives you an idea of how quickly you are going to get
13 surface runoff.

14 If you have a restricting layer very
15 close you're going to tend to get surface runoff and
16 have erosion. The detachability is really how
17 sensitive is that particular soil material to -- part
18 of detachment, the transport.

19 The permeability factors also relate to
20 the -- in the same way as the depth of restricting
21 layer, that you get an idea of: Are you or are you not
22 going to have a high probability of surface runoff.

23 You can have all the exposed soil in the
24 world, if you don't have surface runoff, you're not
25 going to get surface erosion. So, again, you add a

1 series of points and then come up with a rating.

2 The fourth and final sensitive assessment
3 that is undertaken is on page 10 and 11, and there are
4 three components, the first one being - and this would
5 really have been picked up usually at your -- at an
6 earlier level if they're historic failures, or if you
7 see the presence of soil creep, trees being
8 jackstrawed, and it looks like this is a historic area
9 of instability, it immediately goes into a very high
10 category and you would have to look at bringing in some
11 type of geotechnical person to deal with those issues.
12 Basically if it's already unstable, you don't want to
13 do anything to make it worse.

14 The second set under B of the hazard
15 rating key deals with, not in mass wasting like, you
16 know, wet type, it deals with the problem of dry
17 ravelling which is a problem when you're dealing in a
18 lot of glacial soils, like drumlin areas where you have
19 a lot of sands.

20 And if you cut them, you open them up and
21 then they will start eroding back to an angle of repose
22 when you put in your road cut and you take that away.
23 And that's more a function of the angle of repose, the
24 material and the steepness of the slope.

25 So we've tried to address that one, and

1 that is -- that rating comes out specifically, it's
2 based on the steep -- the steeper the slope when you --
3 if it's going to ravel, the longer back the cut is
4 subsequently going to go, the more erosion you're going
5 to have.

6 The main one that we deal with most of
7 the time on an operational level, probably A is
8 generally taken out, B is a problem of just some
9 specific soil types, but C, the type of what we deal
10 with, we're trying to relate this to operations so
11 we're looking at what is the probability if we put in
12 roads, skid roads, you know, haul roads, of having cut
13 slopes and slumps, cut slopes slumping down, fairly
14 localized, maybe 5, 10, 15 metres in length, but coming
15 down in mass, a shallow rotational failure. The reason
16 being that these are encountered a great deal, they're
17 very problematic from a management standpoint.

18 Again, this is relatively similar to the
19 erosion, the surface erosion key where we have, you
20 know, a rainfall factor, that's how much water is in
21 the system, an inherent site moisture, which would come
22 out of the ecosystem classification, some topographic
23 factors, some soil factors, and then again working it
24 through to an individual, a mass wasting hazard.

25 And this is the type of process that we

1 teach at the workshops. We have not added any data --
2 new data to be collected beyond what was standard
3 information collected in our normal preharvest
4 silvicultural prescription process.

5 This comes together and where it was tied
6 into the degradation -- the regulations, if you were to
7 look at page 12 - and this is really where those
8 regulations come out of this type of process - that the
9 regulations, and that -- I mean that standard is set
10 based on the highest hazard you have of these four, and
11 that's where you get this 19, 19, 9 and 4.

12 And it's the highest of your mass wasting
13 hazard, displacement hazard, and then our inherent
14 compaction and surface erosion hazard are minus
15 aquatics.

16 The reason for the minus was that this
17 was initially a hazard rating and is still the hazard
18 rating but we now make an inherent assumption that if
19 you have a high surface erosion hazard or a high
20 compaction hazard, that they will be addressed by some
21 type of management system.

22 It will go -- you know, it will
23 effectively go in -- if you've got it, we're giving the
24 boys credit for dealing with it, but it's the highest
25 of this.

1 With surface erosion hazard there is a
2 footnote that if you have -- even though the overall
3 sensitivity we have softened the impact or softened the
4 rating for surface erosion in determining these
5 guidelines -- the standards, if you have a very high
6 sensitivity water resource, then we have the
7 opportunity to -- that one can be bumped back up, that
8 the water resource may supersede.

9 What this really does it defines what is
10 the most limiting factor in the system and you will
11 basically manage towards that constraint.

12 In the low, moderate, high and very high
13 overall ratings and the guidelines, you have noticed
14 there's a range there. I mean, you're allowed 19 per
15 cent of the area on low and moderate, 9 on -- I mean,
16 yeah, 9 on high, and 4 on very high sensitivity.

17 That range is tied back to this, that a
18 lower sensitivity area can withstand more of these
19 landings, skid roads and skid trails without having an
20 excessively detrimental impact either on or off site
21 than, say, a very high sensitivity site that would,
22 even with a little bit of activity, you have the
23 potential for some very significant impacts,
24 particularly with regards to erosion processes, because
25 many times erosion aggravates over time and what may

1 have once been 9 per cent on a high site, we've gone
2 back and this erosion has progressed several years
3 later that's probably up to like 14 or 15 per cent. So
4 that's sort of incorporated into the system.

5 As far as going through the first part
6 and coming up with the sensitivities, I tried to be
7 brief because the material is here, but are there any
8 other questions with regards to...

9 Q. All right. I just had a couple of
10 questions flowing out of that and I'll be brief.

11 First of all, in the workshops that you
12 make reference to, who would you be giving lectures to,
13 what would their qualifications be, what would
14 ultimately be the purpose of you informing them and
15 explaining to them how this field study would operate?

16 A. In the past three years we have given
17 26 workshops. In the level of attendance and who was
18 attending has changed dramatically over the time --
19 over the two to three years.

20 In the beginning we were getting people
21 that were higher up, foresters that were more
22 interested in what is all this site degradation stuff
23 about because they were worried about their standards,
24 but as the standards became -- everybody realized they
25 were reality and would have to be dealt with, the

1 people -- and what this was really devised for is what
2 we would call a technician or resource assistant level,
3 the people that are, you know, out there in the field
4 doing the data collections. It's geared not just at
5 planning foresters but at the technician level,
6 resource assistant, or field personnel.

7 A number of companies over the past few
8 years have sent -- we have had road building
9 contractors, Cat operators. One company in particular
10 sent their entire operator group, 60 Cat and skidder
11 operators to this workshop, we actually had a special
12 one for them, the matter being they wanted -- that they
13 felt that it was very important that their field
14 people, if they can't work the entire keys, that they
15 understand the process and they understand the
16 guidelines and what is going to have to be achieved by
17 them.

18 At the time there was a friend of mine
19 that was the vice-president of the forest company and
20 his statement to 60 operators was: We may or may not
21 really love these standards, but that's what's expected
22 of us, our operators are expected to be aware of this,
23 you're expected to achieve these because if we get
24 fined or penalized because of your disregard, you will
25 not work around here again.

1 And in some of these areas when there's
2 only one forest company for as far as you can see, a
3 lot of people don't want to go.

4 The ground people, the tech -- the
5 operator level people have been very receptive to it.
6 There is a companion workshop now that was developed
7 primarily through the Forest Research Institute of
8 Canada for operators, takes out a lot of the, you know,
9 the planning, but they incorporate this with operator
10 skills and training so it's -- this one's a planning
11 level, but there is a companion, a simplified version
12 to a one-day, let's take the Cat operators out, give
13 them a little bit of soils background, let them
14 understand what's going on.

15 And that is -- in the long run it's where
16 the gains are being made. When we have had operators
17 on course and we do have half a course in lecture and
18 half a course in field time, I personally prefer having
19 the operators in my group because not only are they
20 learning but they work on the ground all the time and
21 they see how they can very quickly modify what they may
22 have been doing to achieve better results.

23 Q. Dr. Carr, what's the length of the
24 workshops that you have been holding in terms of day or
25 hours?

1 A. The current workshops are two days.
2 It's three, three and a half hours of lecture in the
3 morning, then we go out into the field to go through --
4 we go out and dig soil pits, we take the people through
5 this system that's just been prescribed, that I've just
6 gone through, and then the second day we present
7 them -- now, that they can determine the site
8 sensitivity, we explain thoroughly how the standards
9 work, what's expected of them, and then we take them
10 through the second half of this document from page 15
11 on, which is to provide them with the tools and
12 information necessary to make a prescription for that
13 site sensitivity and meet the standards.

14 I mean, it's not just throwing standards
15 out there at them, the second half is to: All right,
16 we have a moderate or a high sensitivity site, how do
17 we operate there, and that's the second component of
18 the workshop is, we go through a range of practices,
19 options, decision-making process for them.

20 So that, you know, they can make a better
21 prescription. As I say, initially this was a planning
22 document.

23 Q. Have you had any feedback in respect
24 of your workshops, Dr. Carr?

25 A. The feedback that we have had has

1 been excellent. Sometimes when you give these you
2 never know if they're listening or not. If you're
3 looking at a guy who's made his living on Cat, you
4 know, we have class evaluations and course evaluations
5 that have been very, very favourable.

6 In the first two years we only had, if I
7 can remember, I think it was three negative evaluations
8 come back. One of them intriguing was because we
9 didn't supply donuts he thought that the workshop was
10 terrible because of that; another was a fellow was
11 complaining because his union agreement said he got an
12 hour sit-down lunch, and we had a group of 40 people
13 and we had an hour and a half travel distance, so it
14 was like: Well, we usually eat on the run; and we had
15 another fellow from the Ministry of Forests who said I
16 came here to learn how to take away their AAC.
17 Basically he wanted to learn how to penalize them and
18 you didn't tell me that.

19 We are undergoing right now an extensive
20 questionnaire system, also finding out how they -- you
21 know: You've had the system and you've been using it
22 for -- the company, either one or two, some people
23 three years, now how do you like it, where are you
24 finding holes in it. But we have travelled to various
25 regions more than once. Most people say they really

1 like it, it's very easy -- once you go through it it's
2 a very simple system to use.

3 Several people have come up and said
4 it's the most practical workshop they had ever been at.
5 So it's been a number of us developing the workshop.
6 I'm not trying to brag or anything, there are other
7 people besides Terry and myself a number of hours, but
8 we seem to have developed a very effective system.

9 Q. Dr. Carr, to what types of terrain is
10 the field guide you've just reviewed for us intended to
11 be used?

12 A. The field guide was intended
13 applicable and was intended for the entire interior
14 regions of British Columbia. It deals from a whole
15 range of very flat ground, as you can see we have
16 ratings of 0-15 per cent slope to 60 per cent plus,
17 and that being a somewhat more mountainous terrain. So
18 it was designed for the entire interior of British
19 Columbia.

20 There have been local modifications of
21 the key, but they're very rare. So I don't see there's
22 any terrain limitation at all.

23 MR. O'LEARY: Madam Chair, I just have
24 several more questions and then we would be going into
25 a new area. I was wondering, with your permission,

1 whether I could continue and then we'll break.

2 MADAM CHAIR: How long will you be, Mr.
3 O'Leary?

4 MR. O'LEARY: I wouldn't imagine more
5 than five or 10 minutes.

6 MADAM CHAIR: All right. If we can get
7 through this last part quickly, we'll hear it now.

8 MR. O'LEARY: Q. Dr. Carr, what types of
9 validity testing has the system been subject to?

10 A. The system has been -- as I say, was
11 an interim system for the past two years and it has
12 been through a fairly considerable testing process, I
13 would imagine.

14 We've been using our workshops and our
15 lecture series to field test the guide. We've had 26
16 of them throughout the province. When you have three
17 or four groups out there digging soil pits and working
18 through, they will tell you very quickly whether they
19 think that: Well, this doesn't look like a high
20 erosion site to me and yet this key says high, what's
21 wrong. And from that standpoint, there hasn't really
22 been any major complaint that we have ever had filed
23 that the system was overly biased one way or another.

24 So three years, 26 workshops, and 750
25 foresters and students later it still is very much an

1 in tact system.

2 Q. All right. Dr. Carr, are there any
3 studies underway currently or intended that would be
4 devoted towards the improvement or any change in the
5 precision and understanding the cause/effect
6 relationship?

7 A. Yes, there are. I have mentioned a
8 little earlier that there's still a substantial amount
9 of -- a number of research projects undergoing, being
10 undertaken in British Columbia. They range from the
11 retrospective studies, the testing of the soil
12 measurement, our measurement and assessment procedure
13 trying to make that even more effective and more
14 precise.

15 There are a number of long-term growth
16 and yield studies that are being undertaken. We have
17 within the BC Ministry of Forest Research Branch there
18 is now almost an entire sort of section devoted to soil
19 degradation and rehabilitation.

20 Actually they call it the Site Deg Rehab
21 Committee, and these studies are being undertaken
22 throughout the interior of British Columbia. It's a
23 lot of work that we are trying to improve on. The
24 sensitivity, they're going back to look at areas and
25 see whether the sensitivities are really matching up

1 from our keys as well. That's part of the
2 retrogressive component, there is monitoring aspect of
3 this.

4 So a fair bit of work involved to improve
5 this process.

6 Q. All right, thank you.

7 MR. O'LEARY: Madam Chair, those are our
8 questions for today.

9 MADAM CHAIR: Thank you very much, Mr.
10 O'Leary. Thank you, Dr. Carr. We will begin again
11 tomorrow morning at nine o'clock.

12 ---Whereupon the hearing adjourned at 4:15 p.m., to be
13 reconvened on Tuesday, January, 21st, 1992,
commencing at 9:00 a.m.

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